POWER PLANT ENGINEERING

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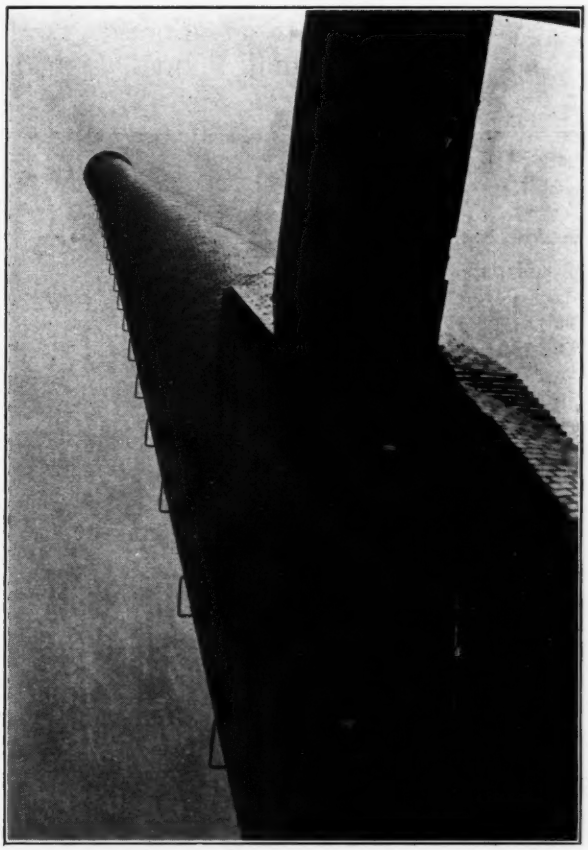


There Ain't No Santa Claus!

NO SIR; there ain't no Santa Claus could get down this chimney! In the first place, it isn't that kind of a chimney and secondly, if it were, no Santa Claus in our opinion would be foolish enough to even want to go down it. For this happens to be the chimney at the State Teacher's College at East Stroudsburg, Pa., and school teachers, you know, are notoriously skeptical about such things as Santa Claus. They don't put up with such foolishness but are more serious and incline towards the higher things in life.

Well, then, they should be interested in this chimney for certainly it is the highest thing on the campus and without it their college would be a cold place for it serves the heating plant—that, however, is another matter and since it is fully discussed in the leading article of this issue, we won't go into it here. This rather unusual view of a stack, however, makes one wonder what a flue gas thinks about getting up in the world.

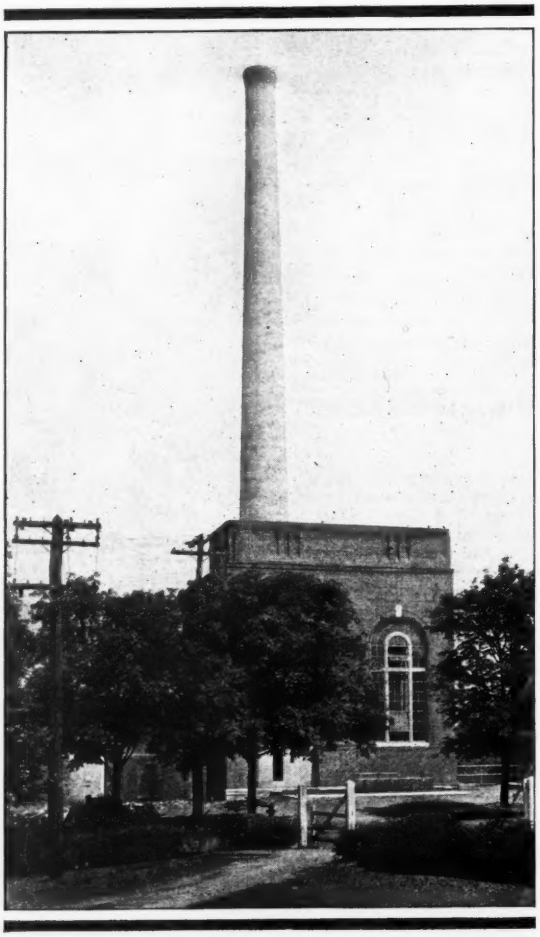
Compact Design, Feature of New College Boiler Plant

New Heating Plant for the State Teacher's College at East Stroudsburg, Pennsylvania, Uses Anthracite Coal on Forced Draft Chain Grate Stokers. A Small Plant Designed on Modern Lines

FROM THE POWER plant engineer's viewpoint, a mere heating plant is of less importance than a plant devoted to the generation of electric power. And in this view, the power plant engineer is quite justified, for an electric generating plant is more complex than just a boiler plant and the problems involved in the economical production of electric power are considerably more involved than those encountered in the production of steam for heating. The large unavoidable losses inherent in power generation make it necessary to pay the utmost attention to the last detail in the process of generation; in the production of steam for heating however, the process involved is more efficient and the details are simpler.

At the same time, a modern heating plant furnishing steam and hot water service to a large building or to a group of buildings often is no small affair and the engineering details demand the same careful attention that is usually accorded the design of a boiler room of an electric power plant; for such a boiler plant has room for all the refinements of practice found desirable in the boiler room for a generating plant and usually some in addition. Such a heating plant often has hot water generators and reducing valves, not found in the electric generating station.

An excellent example of this type of plant is that recently constructed and placed in operation at the State Teachers College at East Stroudsburg, Pa.



BOILER PLANT FOR STATE TEACHERS COLLEGE AT EAST STROUDSBURG, PA.

This institution is one of the many state educational institutions in the Commonwealth of Pennsylvania, and comprises a group of college buildings in an attractive residential section of East Stroudsburg, Pa. The plant, intended entirely for heating service to these buildings, is not a large one as boiler plants go but it deserves attention because of its compactness and excellent engineering design.

This heating plant was built to replace an existing power plant furnishing both steam and electric power to the college. Because of the growth of the college in recent years, this plant was becoming inadequate so a new plant was contemplated. The equipment in the existing plant was approaching obsolescence, making it impractical to extend the capacity of the plant by the addition of new equipment, so plans for a new plant were drawn up.

Until about the time construction was actually started, it was the intention to build a complete new electric generating plant but due to serious curtailment of the budget, the appropriation available for this work was found inadequate to cover the expenses of an entire new plant so it was decided that only a boiler plant be built. At the present time, therefore, the institution purchases its electric power from the local public service company.

As may be noted from the photographs, this plant is attractively designed, its exterior being such as to conform architecturally with the other buildings of the college. It is located at one side of the campus, away

from the college buildings proper but is connected to them by means of underground tunnels carrying all steam, hot water and electric power mains. The transformers used to reduce lines to that used in the college buildings are located in a vault adjacent to the boiler plant and all distribution is effected from that point.

Perhaps the most striking feature of the plant is the atmosphere of cleanliness and neatness that prevails. Large windows admit an abundance of daylight; the floor is of tile and the walls and machine bases are faced with tile.

Since the plant is located on a residential street, the

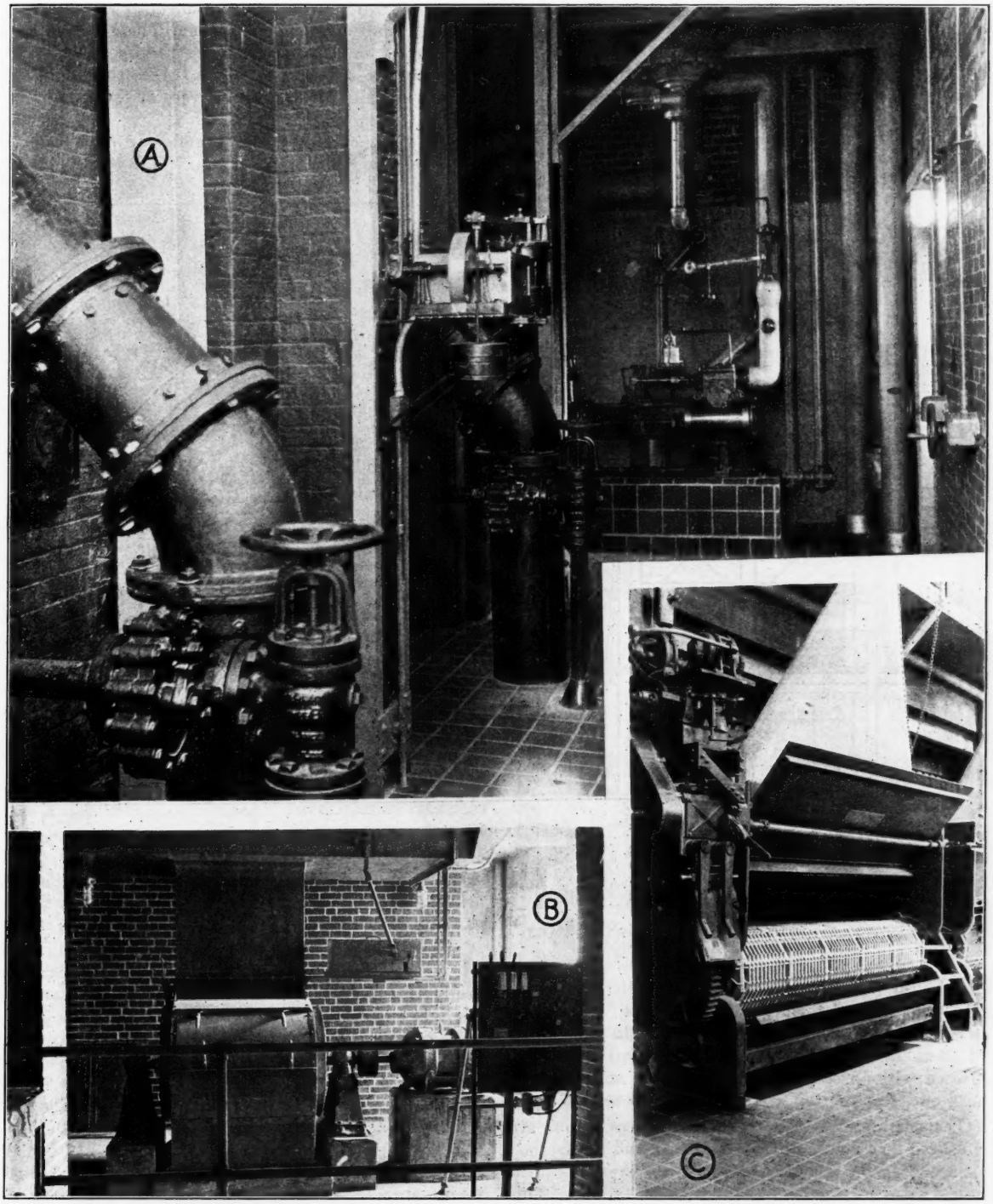


FIG. 1. DETAILS OF THE INSTALLATION AT EAST STROUDSBURG. A. A VIEW BEHIND THE BOILERS SHOWING BLOW-OFF VALVES, AUTOMATIC COMBUSTION CONTROL AND BOILER FEED PUMPS IN REAR. THE LARGE PIPES IN THE FOREGROUND DELIVER DUST AND SOOT FROM LAST PASS INTO ASH HOPPERS BELOW. B. ONE OF THE TWO FORCED DRAFT FANS. C. THE STOKERS ARE DRIVEN BY MOTOR OR TURBINE THROUGH VARIABLE SPEED TRANSMISSION.

problem of coal delivery and handling was one which required some thought. Coal is delivered to the plant by truck. This is dumped into a hopper in the driveway in front of the building which feeds directly into a reciprocating feeder delivering in turn to a vertical bucket elevator. The latter then elevates the coal to the upper part of the building to the overhead bunkers.

Boilers Fired by Chain Grate Stokers

The installation in this plant consists of a battery of two Edge Moor water-tube, longitudinal drum type boilers containing 3300 sq. ft. of heating surface and

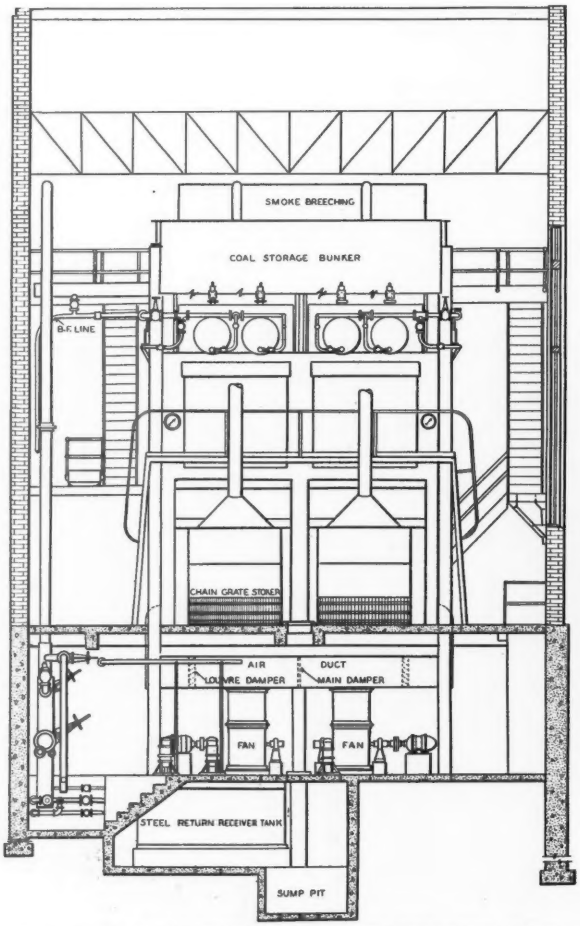


FIG. 2. SECTION THROUGH PLANT, SHOWING PART ELEVATION OF BOILERS

designed for a working pressure of 200 lb. per sq. in. gage. The steam pressure carried normally, however, will not exceed 125 lb. The boilers are 13 tubes high and 13 tubes wide and each has two drums. They are provided with three pass vertical baffling and have the smoke outlet at the top at the rear of the setting.

Of particular interest in regard to those boilers are the rolling doors on both front and rear and the method of suspending the front headers from the overhead steelwork. The rear headers are supported on columns. This method of supporting is shown clearly in the photograph, Fig. 3, which was taken during the early stages of construction. As is evident, the boilers were erected first and the building afterwards. This plan not only facilitated the work of erecting the boilers but furthered the rapid completion of the plant as a whole. The 190-ft. radial brick stack shown in the background, is on a separate foundation, entirely away from the building.

Anthracite coal is used under these boilers. This is fired on McClave-Brooks chain grate stokers, designed for forced draft operation and controlled automatically from the combustion control system. These stokers have individual wind boxes provided with tuyere slides for regulating the air supply. These tuyere slides are controlled manually by means of levers at the side of the boilers.

The width of the furnace chamber in each boiler is 8 ft. 3 in.; the width of the grate, 7 ft. 9 in. Side walls

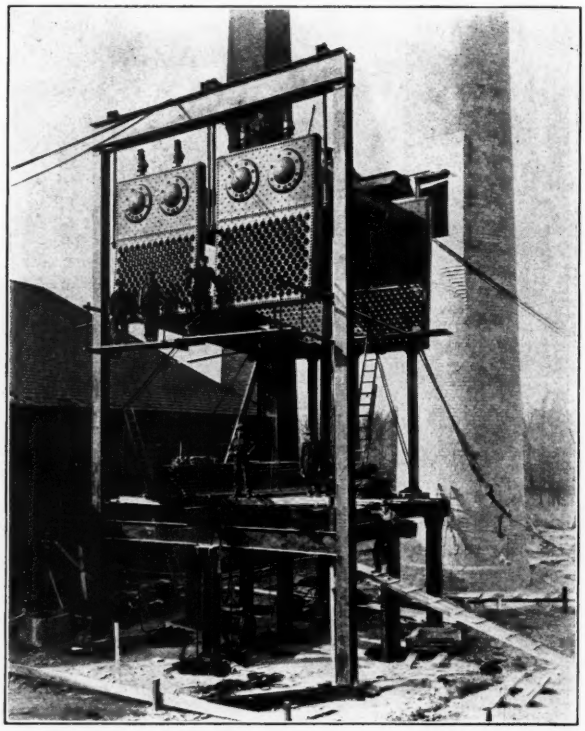


FIG. 3. A VIEW OF THE BOILERS DURING ERECTION

are 22½ in. thick, the middle wall 27 in. thick and the bridge walls are constructed as shown in the accompanying drawings.

Since this plant was placed in operation only early last spring, no data in regard to its performance is available but from the response obtained in handling the light summer load, it is quite evident that the equipment provided is more than ample. With the excellent draft provided by the stack, thus far it has not been necessary to operate the forced draft equipment, except perhaps to accelerate matters in starting up. The boilers are designed on a basis of evaporating 69 lb. of water per hour continuously, from and at 212 deg. F. for each rated horsepower, when fired with No. 3 Buckwheat anthracite coal. The specifications further demand that they be capable of evaporating when forced 86.25 lb. of water per hour per rated horsepower for a period of not less than 2 hours. The stokers are designed to handle No. 3 anthracite buckwheat coal containing

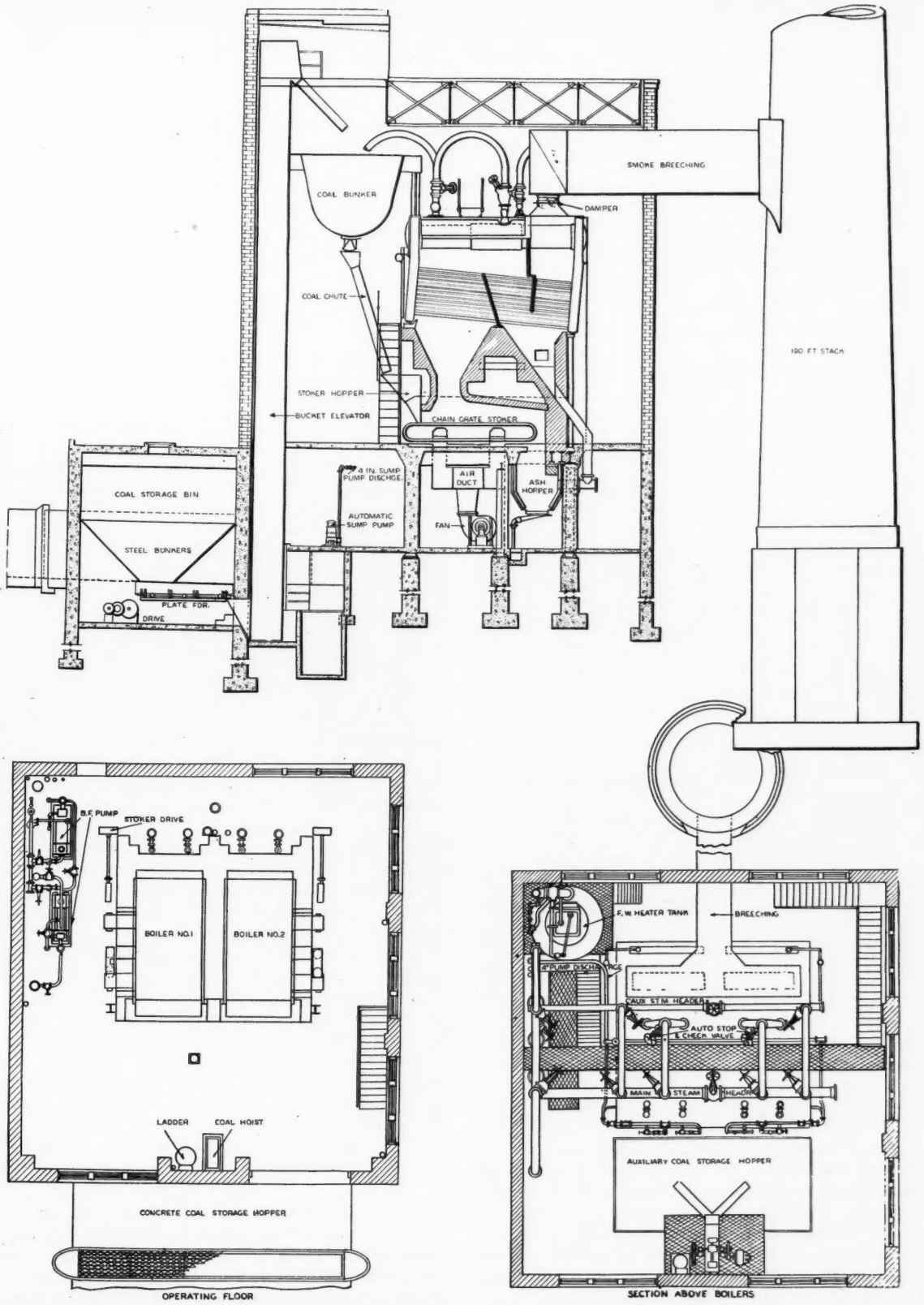


FIG. 4. DETAILS OF PLANT CONSTRUCTION. ABOVE IS SHOWN A CROSS-SECTION THROUGH THE PLANT AS A WHOLE. BELOW ARE SHOWN TWO PLANS, ONE AT THE OPERATING FLOOR LEVEL, THE OTHER (AT RIGHT), ABOVE THE BOILERS

approximately 11,500 B.t.u. per lb. dry and are capable of operating the boiler continuously at 200 per cent rating.

Each stoker is driven either by a General Electric induction motor or by a Carling steam turbine, mounted on the stoker drive mechanism at the side of the feeder hopper. This drive is shown in the photograph, Fig. 1. These drive the stoker through a Reeves variable speed transmission by means of which speed control of the stoker is obtained. The operating mechanism governing the speed control is connected to the automatic combustion control system on the boilers.

Forced Draft Fans in Basement

Two forced draft fans are provided. These are installed in the basement directly below the boilers and

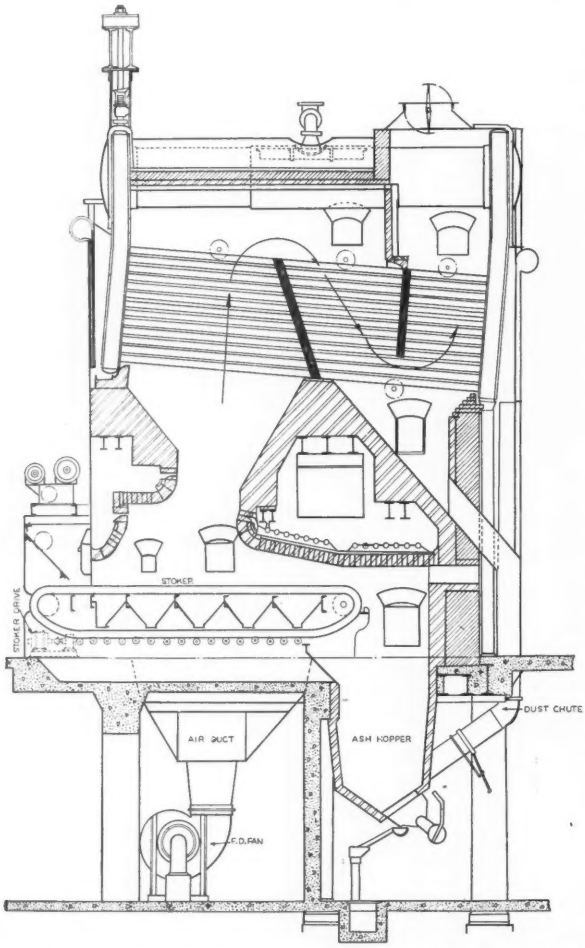


FIG. 5. CROSS-SECTION THROUGH ONE OF THE BOILERS

feed into a common air duct, so that either fan can supply air to either of the two boilers. The fans are Turbo-Conoidal units made by the Buffalo Forge Co. and are driven by 25-hp., 440-v. variable speed induction motors controlled by Westinghouse a.c. magnetic controllers. A balanced louver damper is installed in each fan outlet. This damper is controlled electrically from the automatic combustion control apparatus.

Each of the two fans is of sufficient capacity to operate the two boilers at 150 per cent rating and will deliver 17,700 cu. ft. of air per min. against a statie pressure of 5 in. at the outlet. The air ducts of the draft system are of No. 10 gage black steel plate.

For the automatic operation of the plant, the combustion control system made by the Brooke Engineering Co. is installed. This system operates from the main steam pressure and involves the use of a regulator on each boiler as well as a master regulator on the main dampers and stoker drive mechanism.

Boiler Fittings and Instruments

Boiler fittings include Yarway floatless water columns with high and low level arms, Yarway tandem blowoff valves, Copes feedwater regulators and Vulcan soot blowers. All gate valves 2 in. and larger on high pressure lines are medium weight, flanged, wedge gate valves with special brass seats.

Each boiler is provided with its own instrument panel mounted at the side of the furnace wall where it is within convenient range of the operator. Each of these panels contains:

1. A Bailey boiler meter, recording steam flow, air flow for combustion and flue gas temperature.

2. An 8 point Bailey multi pointer draft gage with an illuminated scale, showing the draft pressure at nine different points in the system; i.e., in the main air duct, in the various wind boxes, over the fire, the stack draft and at the top of the first pass.

In addition to these instruments, one of the panels carries a Ranarex CO_2 indicator and recorder. This is arranged for use with both boilers and is provided with suitable bypass and cross connections so that individual readings may be made on either of the two boilers.

Coal and Ash Handling

The coal handling arrangement has no particularly novel features but it is simple and entirely adequate for the plant's needs. No outside storage is provided, the overhead bunkers in the boiler room having capacity sufficient to take care of the normal storage requirements. The vertical bucket elevator, receiving coal from the reciprocating feeder in the basement delivers directly into these overhead bunkers. The latter are short and ample distribution is obtained by feeding the coal into them through two spouts as shown in the drawings. From the bunkers the coal is delivered by gravity to the stoker hoppers. The entire coal handling installation was furnished by the R. H. Beaumont Co.

Ash disposal is equally simple. The ash is dumped from the ash hoppers directly into industrial cars below. The ash hoppers are provided with hand operated ash gates, and have a storage capacity of 160 cu. ft. each. They are fitted with two quenchers. An excellent feature of the ash disposal system is that the ash hoppers are in a room entirely separate from the rest of the basement, reducing the dust nuisance to a minimum.

Feedwater Supply

Water for the boilers is obtained from the city mains. This is heated to within 2 to 5 deg. of the exhaust steam temperature in a Cochrane open feedwater heater. This heater is installed on top of the regular Cochrane storage and sedimentation tank used in their hot process softening system, but at the present time no chemical treating apparatus is installed. Should chemical treatment be deemed necessary at some future time, it will

be a simple matter to install the necessary additional equipment. The present heater has a capacity of 4000 gal. per hr.

Water from the feedwater heater is delivered to the suction side of the feed pumps under a positive head. Two feed pumps serve the plant. These are 8 by 5 by 12-in. horizontal, duplex, solid cylinder, independent discharge, valve deck type units, brass fitted throughout and made by the Warren Steam Pump Co. As may be noted from the photographs, they are located on the main operating floor where they are within convenient reach of the attendants.

Each pump is served by a one quart, single feed Hills McCanna forced feed, mechanical lubricator and is controlled by a Fisher excess pressure pump governor.

To prevent water from accumulating in the basement three sump pumps are provided. These also are Warren pumps, but are vertical centrifugal units driven

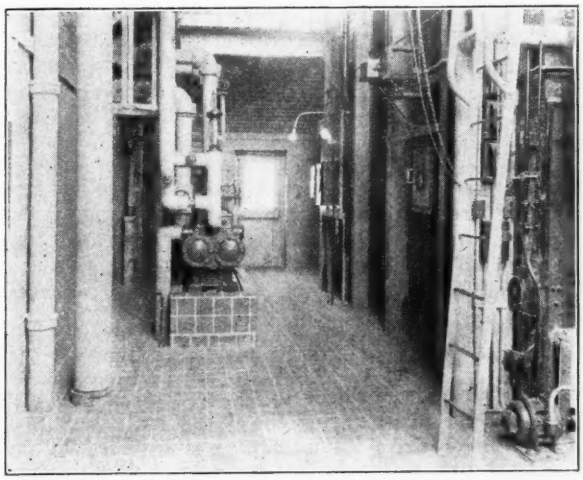


FIG. 6. THE BOILER FEED PUMPS ARE LOCATED ON THE OPERATING FLOOR AT THE SIDE OF THE BOILERS

by 2-hp. Westinghouse motors. They each have a capacity of 60 gal. per min. against a 25-ft. head and are controlled automatically by Cutler-Hammer float switches. In the event of failure of the pumps or of the electric current, these sumps are further protected by a high water alarm. This alarm rings a 4-in. bell when the water rises above a certain point.

From this rather brief description, it will be evident that this boiler plant is well suited to its purpose. Its engineering features have been well thought out and are in accordance with the most modern practice in power plant design. The plant was designed and constructed by the Commonwealth of Pennsylvania under the direction of M. D. Heastings of the Bureau of School buildings. It is to Mr. Heastings that credit is due for information and assistance in the preparation of this article.

AT THE NEW plant of the Hershey Chocolate Co. located at Hershey, Penn., three new boilers which are now being fired by pulverized coal have just been put in operation. Each of these boilers are designed to generate 150,000 lb. of steam per hour at a pressure of 450 lb. when operating at maximum capacity. Two Peabody pulverized coal burners are firing each of these boilers and are designed for 7000 lb. of coal per burner.

Shovel—Crane—Dragline Durability

By G. H. Olson*

IN THE operation of a shovel-crane-dragline powered by an internal combustion engine, to prolong the life of the machine, increase its efficiency and reduce its maintenance cost, every operator should know five simple things that many fail to carry out in the everyday routine of running a machine.

1. Keep the machine and its parts clean and well painted. It will inspire pride in your machine and make it easier to care for.

2. Use good fuel and have it perfectly clean. It will increase the life of the engine and give a more dependable power plant for your work. Fuel should be stored or handled so that no water, dirt or other foreign matter will be introduced.

3. Lubricate the machine properly, using the correct grade and kind of lubricant for each requirement. Lubricate often and carefully but, at the same time, wipe off any excess oil or grease, as otherwise dirt will cling to it. Regulate the lubrication periods according to the amount of service of the machine but don't try to stretch the intervals by putting in twice as much grease or oil at a time. If you don't have a lubrication chart, write to the manufacturer of the machine for one.

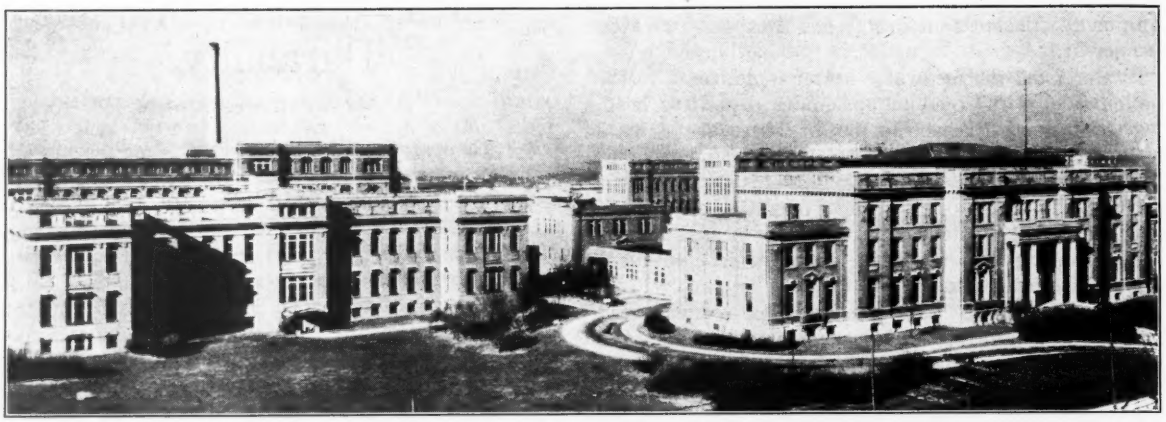
4. Be careful in handling the machine. Don't abuse it by abnormal operation which a little care can avoid. In shovel work, don't try to move a whole mountain in one dipperful but strike the proper combination of cutting depth and height and maintain it. It will be easier on the operator, easier on the shovel and more yards of excavation will be moved at the end of the day. Use powder to break up rock, or other hard excavating, to such size that the shovel can conveniently handle it. Don't try to save a little powder at the expense of the machine. This will result in greater output, less handling cost, and less strain on the machine and operator.

5. Maintain a regular schedule in caring for your machine. The machine will return the attention manyfold by not failing you at the most inopportune time, when you are rushed to turn out a certain bit of work. By regular examination of your machine, you will know when a certain part is wearing to a point where it is safest to replace it or have a spare on hand.

*Link-Belt Co., Chicago, Ill.

HORSEPOWER is and should be replacing muscle power where economy can be shown. That this has not caused unemployment is shown in Iron Age by John H. Van Deventer, who gives charts of wage earners per thousand of population from 1889 to 1929, showing employment to be above the 40 yr. average for years 1923 to 1929; also, that inmates of public charitable institutions per ten thousand of population decreased 46 per cent over the period from 1880 to 1923 and buying power of average wages in manufacturing industries increased 64 per cent from 1889 to 1929.

These figures show that modernization and increased use of power have built and will build up wages, buying power and profits for workers and industries.



Down With Costs and Up With Service

CINCINNATI GENERAL HOSPITAL POWER PLANT MAKES REMARKABLE SHOWING DESPITE INCREASED HEATING AND ELECTRIC LOAD. BY ANTHONY A. FETTE

SAVINGS IN the operation of the Cincinnati General Hospital power plant, in 1929 cut the coal consumption to 601 t. less than in 1928 and again in 1930, 567 t. less than in 1929, with a constant increase in load and service as will be pointed out in the following paragraphs.

Figure 1 indicates the increase in hospital patient population, where in 1923 an average of 450 patients were in the hospital throughout the year, and this service was constantly mounting until in 1930 the average was 868. Naturally the plant load mounted in the same proportion.

In 1929 the electric load increased 22 per cent. An additional building was added to the group of buildings which added 4½ per cent to the heating system. The patient population increased 6.6 per cent and in spite of the above increases 601 t. of coal or 6 per cent visible saving of coal was made compared with 1928.

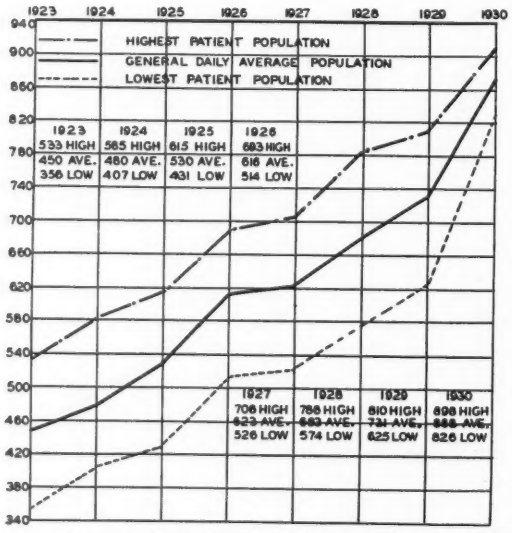


FIG. 1. GROWTH OF PATIENT POPULATION IN CINCINNATI GENERAL HOSPITAL

In 1930 the services increased over 1929 as follows: The electric load increased 13.8 per cent. Another new building was added which increased the heating system 1½ per cent. The patient population increased 18.6 per cent. The boiler load increased 5.4 per cent and there were 567 t. of coal or 6 per cent visible coal saved as compared to 1929.

CHANGES IN PLANT EQUIPMENT

No changes were made in the principal equipment of the power plant during the past 3 yr. except that a new motor drive ice machine was installed in the spring of 1929 to supplement the existing steam driven machine.

Flow meters, recording gages, pyrometers and other instruments were installed in September and October of 1928, shortly after the writer took charge of the plant.

CO_2 recorders were in the plant but were not operating. These were put back into service. Apparently no definite steam pressure had been carried as it had varied from 70 to 100 lb. Quite frequently the ice machine stopped, due to low steam pressure and after the steam pressure was raised the ice machine was again started.

After learning the foregoing, the first instruction was to get the CO_2 recorders in operation and keep them operating. Next orders were given that the steam pressure must not drop below 100 lb. A recording steam pressure gage was immediately purchased and put into service.

We do not know how much the boiler load increased in previous years as no metering devices were in use, but we do know that the electric load increased 143.3 per cent over the load of 1918.

RECORDS SEPARATED INTO TWO SEASONS

In order properly to analyze the hospital plant load, the operating year is considered in two seasons, the heating and the nonheating. The heating season is considered from January 1, to May 1, and from October 1, to

January 1, and the nonheating season from May 1, to October 1.

During the heating season, the outdoor temperature is the controlling load factor and in the nonheating season the electric load is the controlling factor.

Figure 2 illustrates the coal consumption since 1923 for the two seasons. For the heating season the average outdoor temperature is charted over the top of the coal and in the nonheating season the electric load is charted over the top of the coal.

We have made some gains during the heating season the past 2 yr. due to better boiler and furnace efficiency. We noticed that in April of both years the average temperature was the same 56.6 deg. F. but the boiler load had increased 8.8 per cent in 1930 over 1929 for the month while the coal consumption increased only 1.9 per cent. Since the steam for heating the buildings varies with the outdoor temperature, the only savings possible are by better boiler and furnace efficiency.

All through the heating season, there is not enough exhaust steam to do the heating and live steam is required in addition to the exhaust; consequently engine efficiency has no bearing on economy in the heating season. A chart was constructed to see where the greatest savings were made. On the chart the temperature and electric load were shown in reverse order. Our records indicate clearly that the greatest savings were made during the nonheating season.

We have no explanation for the unusual condition in 1923 and 1924 indicated by the heating season coal and temperature curves as I was not present and cannot determine what caused the irregularity, but with those exceptions the remainders of the curves rise and fall consistently. If, however, the same thing were tried on the nonheating part of the chart, there would be no match anywhere. Here the electric load increased more than 133 per cent since 1923 and the coal consumption remained nearly stationary, and dropped off considerably the last 2 yr. where the greatest increase in electric load took place, 106 per cent in 1929 and 133 per cent in 1930 over 1923.

Another noticeable feature of the nonheating season is that with the exception of the last 2 yr., the coal curve rises slightly with the electric load curve.

By the figures of the nonheating season, we notice that the electric load in 1930 increased 13.8 per cent over 1929, but the boiler load, Fig. 3, increased only 9.4 per cent and it is self evident that with an increase in patient population of 18.6 per cent over the previous year, more live steam was used along with more hot water and other services.

We will not try to determine why with more electric load, less boiler load was registered. As previously stated, the steam pressure varied greatly with the average, probably between 90 and 100 lb. It was found that the boiler insurance company allowed 200 lb. steam pressure. Indicator diagrams were taken of the engines and previous old diagrams studied. The old diagrams indicated the electric load in previous years and the notes on the diagrams indicated that the electric load in 1927 would range from 450 to 800 amp. These indicator diagrams were the only record life behind of the load conditions 12 yr. previous when, evidently, it was decided to carry the steam pressure around 100 lb., which gave the engines the proper cutoff.

Steam Pressure Increased by Stages

In 1929, however, the electric load had so increased that the load ranged from 800 to 1200 amp. and often the load would register as high as 1400 and 1600 amp. When the writer took charge, it was the custom whenever the electric load got too heavy to start up the second engine.

In February, 1929, the safety valves on the boilers

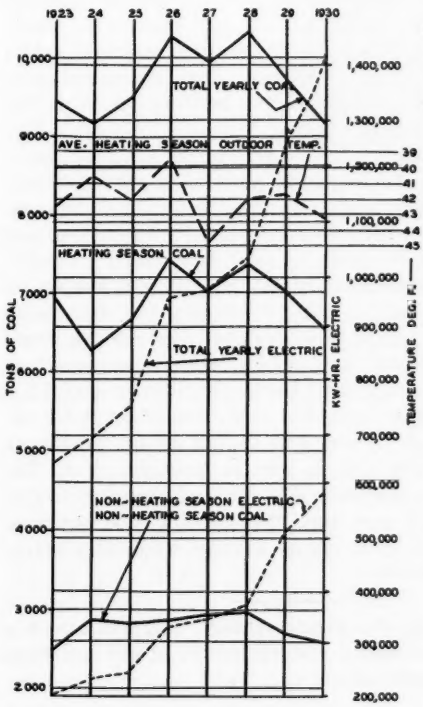


FIG. 2. (LEFT) VARIATION IN COAL CONSUMPTION. ELECTRIC LOAD AND OUTDOOR TEMPERATURE

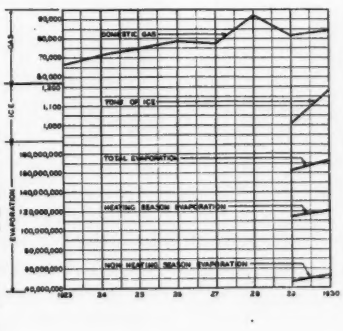


FIG. 3. (ABOVE) GROWTH OF SERVICE LOAD

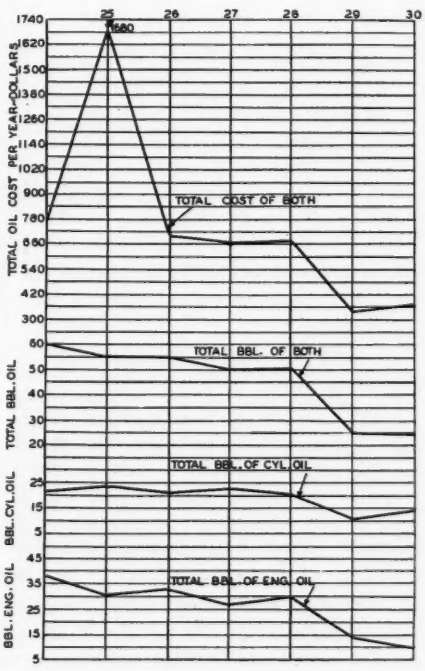


FIG. 4. (RIGHT) CHART OF OIL RECORD

were reset and steam pressure raised to 105 lb.; on March 18, it was raised to 115 lb.; on May 9, to 120 lb.; on May 11, to 125 lb.; May 24, to 130; and on August 2, to 135 lb. and has been carried at 135 lb. since.

With the electric load remaining at 800 amp., it was noted that as the steam pressure stepped up from 95 to 135 lb. the steam admission was reduced from 25 per cent to 8 per cent of the stroke and with a load of 1200 amp. the steam admission was reduced from 40 per cent to 25 per cent at 130 lb. and at 135 lb. the cut-off is at 23 per cent.

On only a few days in the year and then only in the heating season is it necessary to use second engine.

A single steam driven Triumph ammonia compressor has been furnishing ice and refrigeration all the past years and the first task the writer undertook was devising numerous changes, additions and improvements to

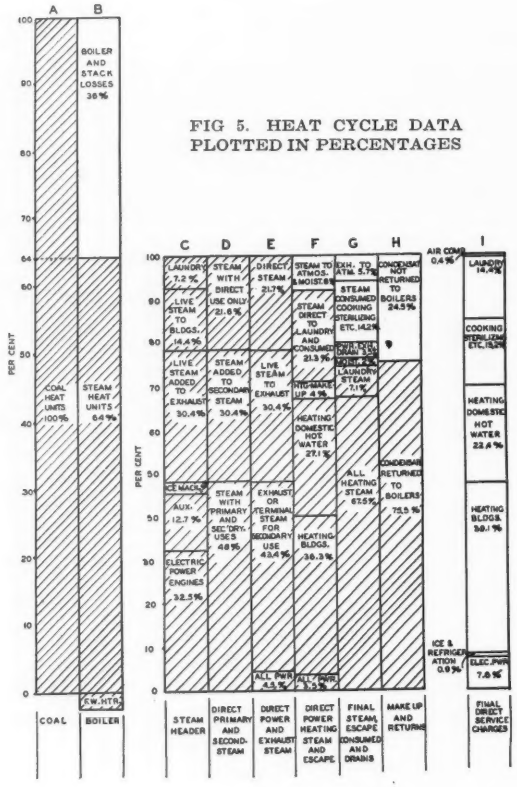


FIG 5. HEAT CYCLE DATA PLOTTED IN PERCENTAGES

the refrigeration system among which was a new compressor and most of the equipment in duplicate for emergencies.

It was immediately decided that the new compressor should be motor driven.

This equipment was installed in the spring of 1929 and as soon as the compressor was installed it was placed in operation. The steam unit is now used in the winter and the motor driven unit in the summer. The boiler room equipment is also steam and motor driven the same as the ice machines, and makes a nice balanced condition, for the light load is heaviest in the winter and the power load heaviest in summer, making the total electric load a straight curve the year around.

The boiler and furnace efficiency played a great part in fuel saving, which was most noticeable in the month of May of the 2 yr. of 1929 and 1930. But it is evident that raising the steam pressure produced even better results. In 1929 the boiler and furnace efficiency was 64 per cent for the entire year; in 1930, 70 per cent; in May, 1929, 62 per cent and in May, 1930, 73 per cent and the boiler load for May of the 2 yr. was nearly a balance where in May, 1929, the evaporation was 11,215.400 lb. and May, 1930, 11,256.000 lb. or an increase in May of 1930 of 40,600 lb. which was a difference of slightly more than 3 hr. out of balance or 0.3 per cent.

The coal used in May of 1929 was 652.25 t. and in May of 1930, 564.80 t. making a saving of 87.45 t.

The electric load in May, 1929, was 94,510 kw-hr. and in May, 1930, 112,990 kw-hr., an increase of 18,480 kw-hr. or 19.5 per cent with only 0.3 per cent more boiler load.

Had the efficiency of operation remained the same in 1930 as it was in 1929, by direct proportion we calculate that 654 t. of coal would have been burned during May to generate the steam or 89.2 t. more than was actually consumed which represents, at $3.65 per ton, a saving of $325.58 for the month of May.

Thus it will be seen that the savings accomplished in this plant were the results of increased steam pressure, the addition of a motor driven ice machine to supplement that driven by steam and, most important of all, the strict adherence to operating rules with well kept instruments and records to guide those in charge.

British Electric Power Station Efficiency

IN THE RECENTLY-ISSUED report for 1930 of the Electricity Commissioners of Great Britain, some interesting details are given of the thermal efficiencies of the steam-operated electric power stations. The report shows that the new Kearsley station of the Lancashire Electric Power Co. heads the list for the highest thermal efficiency with a figure of 23.84 per cent. The power generated at this station during last year amounted to 129,624,646 kw-hr.; the average fuel consumption is shown as 1.17 lb. per kw-hr., the maximum load on the generators as 35,000 kw. and the load factor as 42.3 per cent. The Deptford (West) works of the London Power Co., Ltd., takes second place with a thermal efficiency of 23.20 per cent. The power generated amounted to 280,819,210 kw-hr.; the average fuel consumption was 1.29 lb. per kw-hr., and the load factor 43.3 per cent. Closely following Deptford is the Barking station of the County of London Electric Supply Co., Ltd., with a thermal efficiency of 23.02 per cent, a power generated figure of 543,354,400 kw-hr. fuel consumption was 1.38 lb. per kw-hr., and a load factor of 37.2 per cent. The average fuel consumption for the steam stations for the period under review was 1.90 lb. per kw-hr. generated, as compared with 1.97 lb. for the previous year. The highest thermal efficiency shown for oil engine operated stations is 30.18 per cent, representing the works of Buxton Corporation, with an average fuel consumption of 0.61 lb. per kw-hr.

ACCORDING to the kinetic theory, temperature is a measure of the velocity and amplitude of the molecules or atoms of a substance.

Air Conditioning a Steam Engine

VENTILATING SYSTEM THROUGH WHICH OIL MIST IS WITHDRAWN DECREASES OIL CONSUMPTION OF LARGE STEAM ENGINE

SEVERAL MONTHS AGO, in the engine of a large industrial plant, the oil fog around the crosshead guide of the engine had increased to such an extent that the engineer was afraid oil would get into the generator. As shown, the crosshead guides and crankpit are completely enclosed, according to the usual modern practice. To eliminate this fog, which also kept the outside of the engine casing oily all the time and contaminated the air around the engine, a simple ventilating system was designed to pull the fine oil mist out of the crosshead casing and tailrod casing. As a result, there is no indication of oil getting into the generator windings, the oil consumption for the engine has decreased materially and bearing temperatures throughout the engine have been greatly reduced.

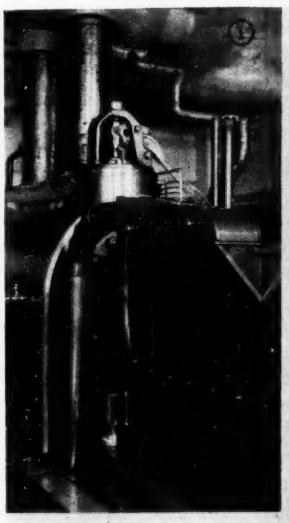


FIG. 1. SHEET METAL DUCT FROM CROSSHEAD CASING RUNS UNDER FLOOR TO BLOWER

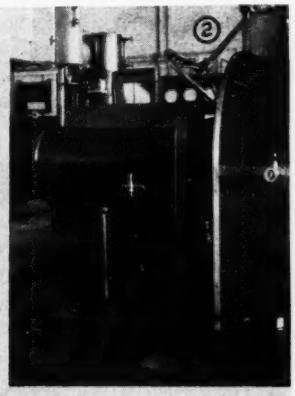


FIG. 2. FROM TAILROD CASING RUNS ANOTHER DUCT

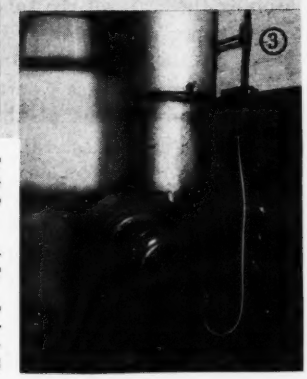


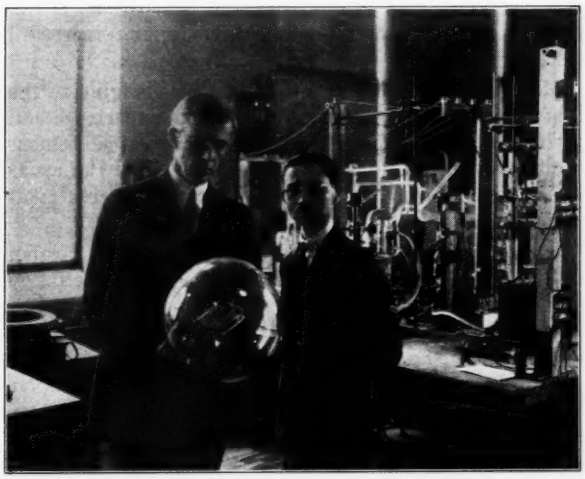
FIG. 3. BLOWER DRAWS OIL MIST FROM ENGINE CASINGS AND OIL IS SEPARATED IN BLOWER DISCHARGE

Construction of the ventilating system is clearly shown in the photographs. An opening is made in the crosshead casing from which a 5-in. sheet metal duct, Fig. 1, leads under the engine room floor to the blower, Fig. 3, located about 20 ft. away in a room behind the switchboard. Another opening was made in the top of the tailrod casing from which a smaller square duct, Fig. 2, leads to the round duct under the floor. The blower, driven by a 2-hp. motor, draws the oil vapor out of the engine casings and discharges it through a duct running to the outdoors. In the blower discharge line, an oil separating arrangement traps out most of the oil, which is returned to the filter for cleaning and reuse in the engine lubricating system.

All the duct work for this ventilating system was made in the shops of this industrial plant, most of it being welded. The blower and motor were spare units that were found in the storeroom, therefore the cost of the entire installation was extremely low.

A King Is Shown a Lamp

AN INCANDESCENT lamp giving 1000 times as much light as the ordinary household lamp was shown to King Prajadhipok of Siam when he visited the General Electric research laboratory in Schenectady in July. Dr. Irving Langmuir, associate director of the laboratory, is holding the lamp.



Boiler Standardization Throughout the British Empire

BRITISH ENGINEERING STANDARDS ASSOCIATION, as the result of a fully representative conference of boiler makers and users and insurance companies, has nominated a strong executive committee to prepare a set of British Standard Boiler Rules and Specifications. Further, the boiler makers in Great Britain have formed a permanent makers' panel and have nominated some twelve of their number to the Executive Committee to represent the whole of the British boiler makers' interests. The Executive Committee will be at liberty, through this makers' panel, to consult all the manufacturing interests in order to bring to the Executive Committee the consensus of opinion of the producing interests on any point at issue. The Committee is also assured of the fullest support of the engineering insurance companies and it is probable that, at their own request, they will be entrusted with the preliminary work of coördinating certain portions of the proposed rules. The Australian Committee has already signified its desire for cordial coöperation in the work, a notable example being the Australian Boiler Code recently issued, which is under review by the Standards Association of Australia and has been forwarded to the English Committee for comment with a view to ultimate coördination as far as practicable.

Pretreatment of Feedwater Evaporators

PRACTICE OF TREATING WATER BEFORE IT IS FED TO EVAPORATORS IS GROWING IN FAVOR AMONG POWER PLANT ENGINEERS. BY S. B. APPLEBAUM*

TWO SCHOOLS of thought exist regarding the subject of pretreatment of feedwater to evaporators: a. That the evaporators should be able to handle any water without pretreatment and that the scale should be removed by cracking it off the evaporator coils. b. That the evaporator is an expensive piece of apparatus and deserves the best possible water that it can get for decreased maintenance expense and increased efficiency.

Many users of evaporators start off belonging to the first school but after having considerable experience and giving the views of that school a chance to be demonstrated by their actual installation, they join the ranks of the second school by installing proper pretreatment equipment.

Cost of pretreatment apparatus is a small portion of the initial investment in the evaporator installation and it would therefore appear to be "penny wise and pound foolish" to endeavor to omit such pretreatment apparatus at the expense of loss of efficiency from the evaporator, plus heavy maintenance expense for repair of evaporator coils damaged in the cracking process.

The tendency in this regard is well illustrated in the 1929 Prime Movers Committee report of the N. E. L. A. entitled, "Treatment of Feedwater" Page 1:

"Of the 24 plants using evaporators, ten pretreat the evaporator feed. Of these ten, six use zeolite softeners while one employs a unit system of evaporators and has a zeolite softener installed ahead of only one of the four units."

In Power Plant Engineering of January, 1930, on page 38 in the article entitled, "Feedwater Treatment" the following statement appears:

"Evaporation is becoming of increased importance for high pressure plants; in fact, it is standard practice in all central stations. Evaporated makeup does not necessarily mean that absolutely pure feedwater is obtained. The carryover of the evaporators, condenser leakage and high evaporation rates in these boilers make it necessary to keep a close watch on the boiler water conditions. Treatment of water going to the evaporators is used in many plants."

The purpose of treating evaporator makeup is, of course, the elimination of scale in the evaporators. The use of evaporators does not eliminate the problem of scale, but merely transfers it from the boilers to the evaporators. Zeolite treatment removes the scale forming calcium and magnesium from the evaporator makeup water and keeps the evaporator free from all deposits of scale, sludge and mud. The advantages of scale-free evaporators are:

1. The capacity of the evaporator is increased due to better heat transmission through the scale-free tubes.

2. The expense of removing the scale from the evaporator tubes is eliminated.

3. The expense of outages of the evaporators for scale removal is eliminated.

4. Wear and tear on the evaporators due to removing scale is eliminated and the life of the evaporator is prolonged.

5. Scale in boilers is prevented. When the evaporator makeup is not softened, the hardness in the makeup is carried over into the distillate with the moisture in the steam and causes scale in the boilers. When the evaporator makeup is softened, no hardness is present in the distillate.

That the above advantages are actually realized in plants which soften their evaporator makeup by means of zeolite is shown in the following reports of the operation of combination zeolite evaporator plants.

The Southern California Edison Co. uses zeolite softeners to treat the makeup to its evaporators in its Long Beach plant. In the N. E. L. A. 1927-1928 report, on pages 15 and 16, the following statement appears:

"The zeolite system at the Long Beach plant No. 2 of the Southern California Edison Co. was installed for the purpose of removing scale-forming constituents from the evaporator feedwater. Prior to the installation of the zeolite system, considerable trouble had been experienced due to the formation of scale on the evaporator tubes. This scale was hard and would not crack off, hence frequent cleanings were necessary, causing low evaporator operating efficiency and capacity.

"The evaporators were cleaned once a month by chipping the scale off the tubes by hand. This required 1½ days per evaporator at a cost of $100 or $400 per month for the complete installation.

"Acid treating was resorted to at a later date and was used for a period of about four months.

"A clean evaporator will evaporate 9000 lb. of water per hour. The average evaporation from one cleaning to the next was 6052 lb. per hr., or 67 per cent of the maximum. In addition to this, there is also the loss in capacity, due to the evaporator being out of service during cleaning, which amounts to about 1 per cent for the acid cleaning and 5 per cent for mechanical cleaning. . . .

"Since the installation of this zeolite system over a year ago, no cleaning of the evaporators has been necessary and the evaporator capacity has been maintained at maximum rating at all times."

The N. E. L. A. 1928-1929 report, on page 2, described another zeolite evaporator combination as follows:

"Ohio River water treated with lime and alum to remove suspended organic matter and bacteria is fed to evaporators 1, 3 and 4, but the water for unit No. 2 is also treated by Permutit water softener.

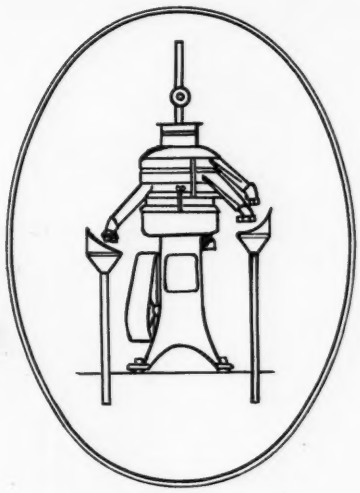
"The average output of evaporators 1, 3 and 4 is 5500 to 6500 lb. per hr. whereas unit No. 2 delivers about 7500 lb. per hr.

"Evaporators 1, 3 and 4 are 'cracked' with cold water every day and manually cleaned every 6 to 8 weeks, requiring about 27 man-hours for each cleaning. Unit No. 2 does not require these cleaning methods."

Also in the above plant, the softening of the evaporator makeup eliminates scale and increases the evaporator capacity.

*Vice President, The Permutit Co.

DIESEL ENGINE UPKEEP



PART XVI. LUBRICANT CLARIFICATION MORE IMPORTANT IN REDUCING SHUTDOWNS THAN IN SAVING OIL. MAINTENANCE OF LUBRICATING OIL CLARIFICATION DEVICES. TYPES. HEATING AND COOLING.

BY EDWARD J. KUNZE.

UNTIL RECENT years, lubricating oil was thought to wear out or lose its lubricating quality in use. Now we know that good oil becomes unfit for use, not because of the oil itself, nor of the duty imposed upon it but because dirt, water, metal particles, other foreign matter and air become mixed with it. By removing these foreign substances as they accumulate, the oil is not alone freed of these undesirable elements but others, such as acid and sludge which result directly from agitation of oil mixed with such impurities, are removed also. Such removal now is possible with modern clarifying equipment and good oil may be reused indefinitely when it is properly clarified.

COLOR MAY BE RESTORED

Formerly, darkened color of used lubricating oil was thought to indicate a depreciating change in the oil itself; today even the original color of the oil may be almost entirely restored by proper clarification. Darkening of oil is due chiefly to the introduction into the oil of a large amount of carbon much of which is so finely divided as to cause it to remain in suspension after days of settling. Darkening is caused, also, by the intense heat to which cylinder lubricating oil is subjected in a Diesel engine.

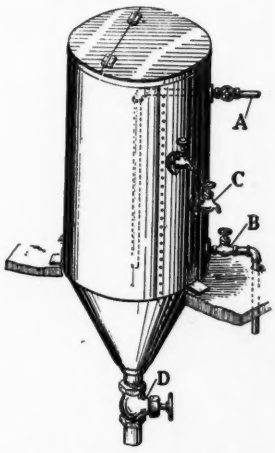


FIG. 1. SETTLING TANK EQUIPPED WITH ARRANGEMENT FOR BLOWING THE OIL WITH STEAM

A—Steam line. B—Clean-oil discharge. C—Test Cock. D—Waste.

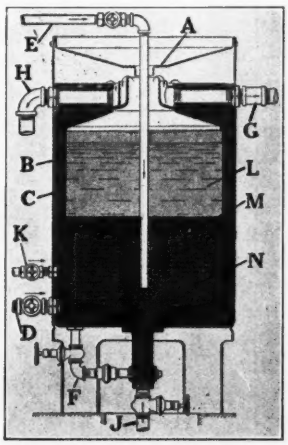


FIG. 4. TANK FOR CLARIFYING LUBRICATING OIL BY CHEMICAL TREATMENT AND SETTLING

A—Oil-receiving Tray; B—Treating Tank; C—Water Jacket; D—Water Supply; E—Steam Line; F—Connection between Jacket and Treating Tank; G—Clean-oil Outlet; H—Water Overflow; J—Waste; K—Steam Connection to Jacket; L—Purified Oil; M—Sludge and Impurities; N—Water.

Centrifugal clarification removes all impurities except colloidal carbon while it is claimed that even this fine impurity may be removed by the edge type of filtration. Both of the above methods of clarification will remove any sulphuric acid which may be present. Sulphuric acid, which is heavier than oil, causes corrosion of bearings. It is formed by combustion of sulphur-bearing fuels which are water soluble.

Lubricant clarification was practiced formerly with the sole purpose of reducing consumption; today, recovery of oil is considered of secondary importance. Smoother and more efficient operations of engines and reduction of shutdowns and necessity to make adjustments and repairs are now considered of greater importance. Reclamation, however, makes practicable forced and pressure lubrication systems which are being adopted increasingly.

TYPES OF CLARIFICATION

General types of clarification, precipitation and filtration are in use. Their various methods of application may be divided as follows:

Precipitation: Gravity—settling; forced—centrifugal; chemical.

Filtration: Gravity—fabric and screen; pressure—pressure filtration; suction—edge filtration; coagulation.

In many systems combinations of above applications are made. Strainers are often employed for preliminary cleaning in which case the twin type which permits of ready cleaning during operation should be employed. Settling by gravity is a slow process and will not remove fine carbon particles or sludge. Conditions favorable to effective settling are 1. A state of rest; 2. Sufficient time; 3. A relationship between specific gravity and viscosity of the oil and character and relative weight of the impurities which permit these impurities to free themselves readily from suspension.

Even slight addition of oil to tank destroys necessary quiescence. The only advantage possessed by

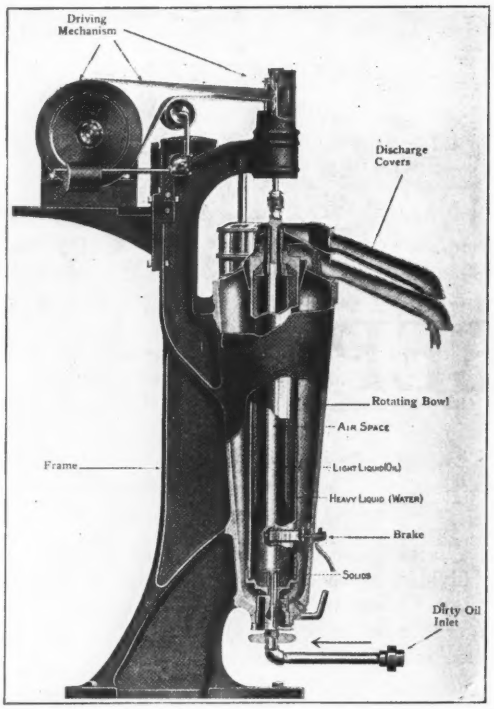


FIG. 2. HIGH CENTRIFUGAL FORCE SEPARATES FLUIDS OF DIFFERENT SPECIFIC GRAVITIES INTO CYLINDRICAL LAYERS IN VERTICAL ROTATING ELEMENT.

settling is its cheapness since all that is needed is a tank and connections. Where this system is employed it is best to have two tanks and alternate the discharge from the engine from one to the other while the companion tank is resting. After settling sufficiently, the oil is drawn from the rest tank and forced into a supply tank.

Equipment for blowing the oil with steam is shown in Fig. 1. The bottom of the tank is made conically to facilitate settling.

Centrifugal Precipitation

In this process, centrifugal force is introduced as the accelerating agent. Two types of centrifuges are in the market. In one, Fig. 2, the rotating element, a tubular bowl, has a speed of 12,000 to 15,000 r.p.m., the dross being thrown out, water taking an outer position in the rotating cylinder and good oil, an inner position. As soon as rotation ceases the liquid in the bowl drains away automatically. Solid impurities which have collected within the bowl may then be removed. Cleaning of this type is simple because of the simplicity of the parts.

Another type, Fig. 3, reduces the resistance to precipitation by thinning the clarifying layers of oil. By this means the necessary speed for adequate separation is 6000 to 7000 r.p.m. Generally, naphtha or gasoline is used to clean the disks of this type. As the machine is cleaned daily, a considerable quantity of cleaning fluid will be consumed by evaporation and waste, moreover the cleaning process is messy. A more convenient and practically costless method is to put the disks, after removal from the machine, into a box of hot sawdust and rub off most of the thick sediment and use dry cloths for finish cleaning. Because of the places which are hard to clean in the spout, naphtha or gasoline should be used for this purpose.

Oil feed through a centrifuge must be suited to the character and amount of contamination. If the feed is too rapid, only partial clarification will result. The feed line to the centrifuge should be located at the bottom of the sump tank and close to the drain line from the engine. This assures removal of the dirtiest oil for clarification. Location of a baffle in the tank over the inlet to the supply line of the engine, provides reception of cleanest oil by the engine. If the engine is not equipped with a sump or rest tank, the supply for the centrifugal machine should be drawn from the bottom of the crankcase through a vented goose-neck, which assures unfailing supply of oil sufficient to hold the oil level at a predetermined height for safe operation of the engine.

When contamination does not yield readily to other clarification methods, chemical treatment sometimes is used. Used solely for precipitation, the chemical process is costly; as a coagulating process which functions mechanically, it is used successfully in many plants. By this method, extremely fine particles of carbon or other fine matter are united with a coagulating agent. Brief but violent agitation by steam of the dirty oil mixed with a solution of hot water containing the coagulant, causes carbonaceous matter to be precipitated in the form of sludge between the oil and water as shown in Fig. 4. It is claimed that the oil is not affected by the coagulant and that all water and foreign matter are removed.

Commercial soda ash may be used as the coagulating agent. A solution made by dissolving soda ash in hot water is added to the inner tank after the dirty oil had been introduced slowly and heated by the hot-water jacket and by the steam agitation to a temperature of about 180 deg. F. After sufficient agitation, the treated oil is allowed to stand overnight.

Filtration systems will be considered in the next article of the series.

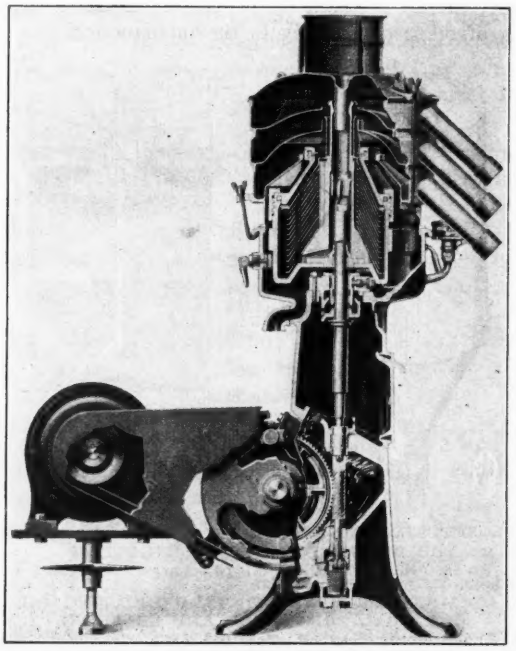
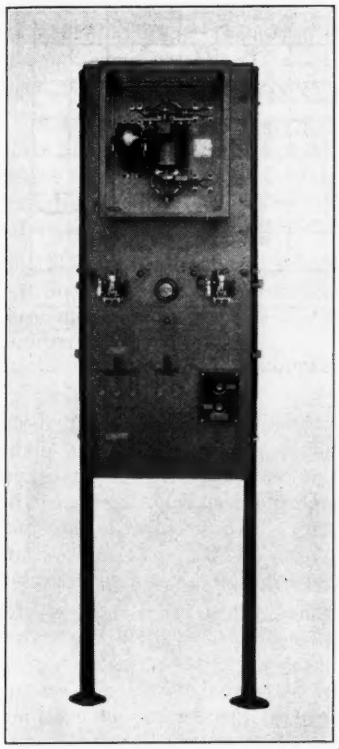


FIG. 3. MULTIPLICITY OF ROTATING DISKS REDUCE THE THICKNESS OF OIL LAYERS, HENCE INCREASE ACTION OF SEPARATION AND REDUCE REQUIRED SPEED OF ROTATION.



Load Regulator for an A. C. Generator.

Load Control in Industrial Plants

By R. R. Ruggles
Industrial Engineering Department
General Electric Co.

AT THE JOINT MEETING of the Association of Iron and Steel Electrical Engineers and the middle eastern district of the American Institute of Electrical Engineers held at Pittsburgh, March 13, 1931, papers were presented by representatives of both the utilities and industrial plants which indicate the growing interest in the possibilities of interconnection between the utilities and industrial systems.

It is brought out clearly in these papers that, in order to make interconnections of mutual benefit to the interested parties, the load demands must be so regulated as to minimize power charges and capital investment.

In order to show how load regulation may be applied advantageously, let us take a hypothetical case of an industrial plant with fluctuating load which purchases power from a large central station but is also equipped to generate a certain portion of its total load requirements.

Let us assume that the industrial plant has a 30-min. demand for 3500 kw. at least once during the month and a total average monthly load of 1,319,500 kw-hr. There is in the industrial plant a 750-kw. generator to take care of vital loads, which supplies energy up to its capacity, taking part of the 3500 kw. demand, and furnishing part of the 1,319,500-kw-hr. load. The total plant load will be similar to Calculation I Load Curve, Fig. 1.

The industrial and central station plants are operating in parallel electrically and the capacity and output of the utilities plant is large as compared with the industrial. Any changes in load in the industrial will be divided between the two plants in proportion to their output. Since the central station plant is large as compared with the industrial plant, the load changes will be taken by the central station, therefore the industrial plant will supply practically constant output over the 24 hr. of the day, or about 468,000 kw-hr. per month.

In arriving at the power bills that follow, the following rates have been used for purchased power from the central station. The demand charge is based on a 30-min. maximum demand during the month.

Demand Charge:
$2.50 per Kw. per Month for 1st 100-kw. demand
$2.00 per Kw. per Month for excess
Energy Charge:
2c. per Kw. per Hr. for first 10,000 kw-hr.
1c. per Kw. per Hr. for excess

Reasonable figures to use for energy which the industrial plant generates would be 1½c. per kw-hr. when generating at full capacity of the generator and 1.7c. per kw-hr. when generating at fractional capacity of the generator.

If the industrial plant generator is tied in with the central station system and without any form of load regulator, the industrial plant's total power bill will be as shown in Calculation I.

Calculation II, Fig. 2, Load Curve shows the division of load between the two generating plants with an automatic load regulator. The industrial plant takes power up to 2750 kw. demand from the central station power plant, and the power above this demand furnished by its own generating plant. The total electric power bill under this arrangement of division of power is shown in Calculation II.

Below the Calculations I and II is shown the saving

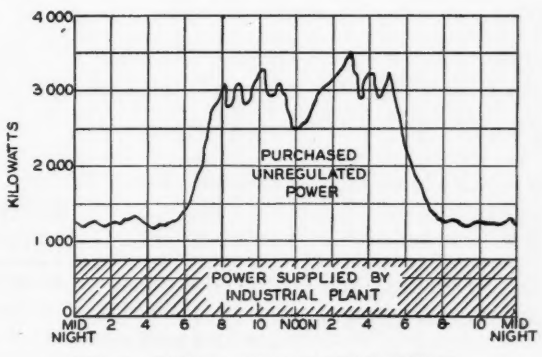


FIG. 1. CALCULATION I LOAD CURVE

in the electric power bill with a load regulator. Let us now see what the effect is on the central station power company.

	Calculation I.	Calculation II
Total Demand	3500 Kw.	3500 Kw.
Demand on Power Co.	2750 Kw.	2750 Kw.
Demand supplied by Industrial Plant	750 Kw.	750 Kw.
Total power supplied by Industrial Plant (Kw. per Month)	468,000	79,500
Total power supplied by Power Co. (Kw. per Month)	851,500	1,240,000
Total power consumption (Kw. per Month)	1,319,500	1,319,500
Demand Charge—		
	\$2.50× 100=\$ 250	\$2.50× 100=\$ 250
	\$2.00×2,650=\$5,300	\$2.00×2650=\$5,300
Total Power Co. Demand Charges	\$5,550	\$5,550
Energy Charge—		
	\$.02× 10,000=\$ 200	\$.02× 10,000=\$ 200
	\$.01×841,000=\$8,415	\$.01×1,230,000=\$12,300
Total Power Co. Energy Charges	\$8,615	\$12,500
Total Power Co. Bill	\$14,165	
Industrial Plant		\$18,050.00
Bills (Self)	\$.015×468,000=\$ 7,020	\$.017× 79,500=\$ 1,351.50
Total Electric Power Bill	\$21,185	\$19,401.50
		\$21,185.00
		−19,401.50
Monthly saving of elec. power bill of Cal. II over Cal. I		\$ 1,783.50
		× 12
Yearly saving of elec. power bill of Cal. II over Cal. I		\$21,402.00

By referring to Calculations I and II and taking the difference in the central station power bill to industrial plant, it can readily be seen that the central station has increased its revenue. This increase in revenue has been obtained without any increase in capital investment for the central station plant as in either calculation the demand on the power company is 2,750 kw.

Table II \$18,050
Table I 14,165
\$ 3,885 per month
× 12
\$46,620 per year increase to central station

The industrial plant generating rate when operating at partial loads has been taken at 1.7c. per kw-hr. Let us see what would be the maximum rate beyond which a load regulator would not show a saving to the industrial plant. This can be found by taking the sum of the industrial plant's own generating power bill in Calculation II and the saving in total power bill of Calculation II over I divided by the kilowatt-hours generated by the industrial plant in Calculation II. This rate will be 3.94c. per kw-hr. as shown by the following:

Industrial Plant's Own Generating Power Bill (Cal. II)	\$1,351.50
Savings to Industrial Plant per Month	1,783.50
Total	\$3,135.00

$$\frac{\$3,135.00}{79,500 \text{ kw-hr.}} = \$.0394 \text{ per kw-hr.}$$

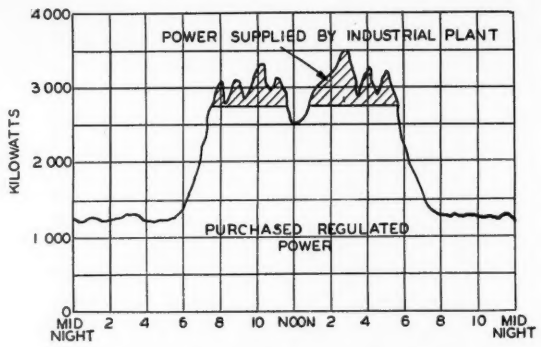


FIG. 2. CALCULATION II LOAD CURVE

It has been shown in the foregoing to be highly desirable to regulate the load in a specific industrial plant. Due to variations in power generated in industrial plants of the total power requirements, together with variations in power costs (both generated and purchased) each plant requires an individual analysis to determine whether or not a load regulator is desirable.

The load regulator herein has been arranged for operation on a prime mover to absorb the power "peaks"; this is the usual way where the amount of purchased power is large as compared with the amount generated in an industrial plant. Plants not equipped with generating equipment have reduced their "peaks" by unloading some of the plant equipment.

In nearly every plant can be found equipment which can be partly or completely unloaded for a short inter-

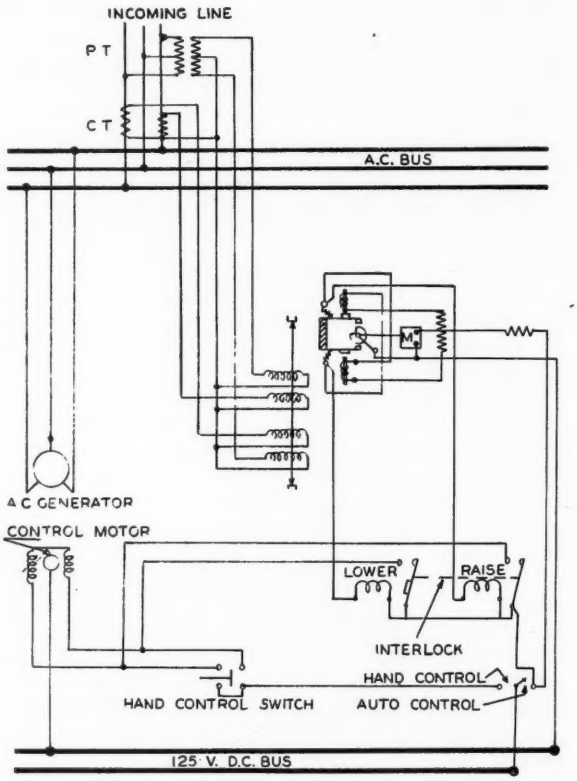


FIG. 3. TYPICAL WIRING DIAGRAM OF AN AUTOMATIC LOAD REGULATOR WORKING ON A PRIME MOVER

val of time when demand is high without interrupting or lessening plant production. Such loads as motor-driven compressors or grinders and the electrically heated furnace allow for short time interruptions.

Some mills having short time operation of parts of their machinery, have found by controlling the time at which they operate that their demand has been reduced and thus reduce their power bill without materially affecting production.

Like the application of a load regulator operating on a prime mover, an individual study must be made of the application of any load limiting or load reducing equipment.

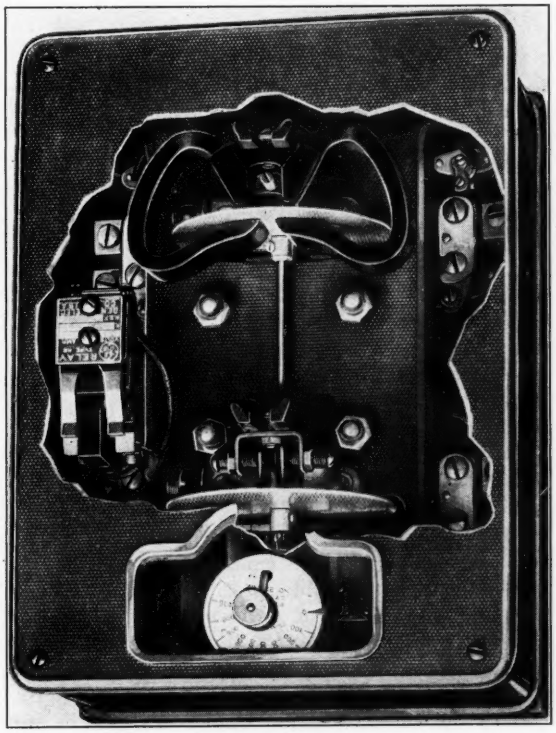


FIG. 4. AN INDUCTION RELAY WITH CONTACTS

Figure 3 shows a typical wiring diagram of an automatic load regulator working on a prime mover and the illustration at the head of this article shows a typical load regulator equipment mounted on a panel. In these figures a contact-making wattmeter is employed with a motor-driven cam to interrupt or break the contacts to give an intermittent impulse to the control motor on prime mover.

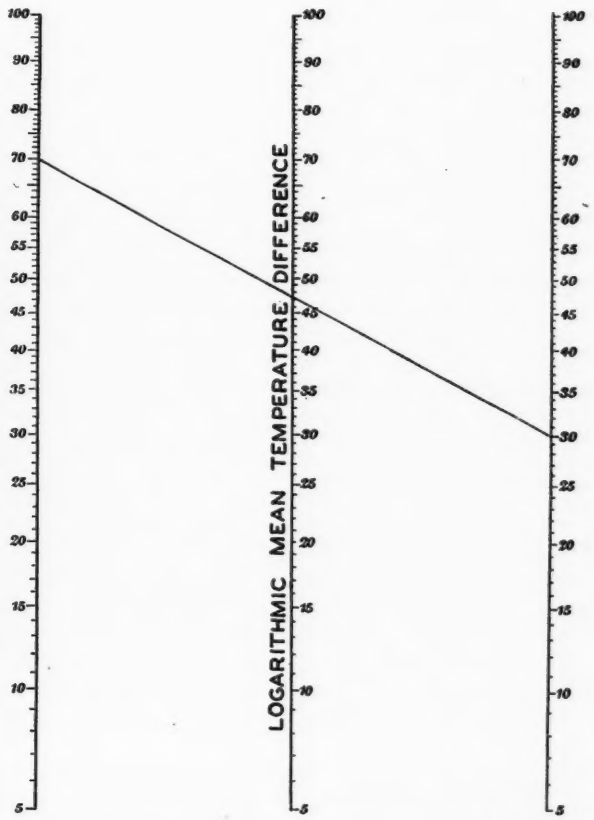
Where intermittent impulse is not required, an induction relay with contacts can be often employed. This relay is shown in Fig. 4 and contains two metal disks mounted on a vertical shaft which is suspended on a torsion wire and held in position by suitable polished bearings. Acting upon these disks to revolve them are two separate driving elements, each consisting of a current coil and a potential coil with an iron core. There is an insulated movable contact on the shaft on a stationary contact. If there is sufficient movement of the shaft, contact is made between the movable and the stationary contacts.

Temperature Difference Chart

FOR MEAN temperature difference between fluids whose temperature changes during heat transmission as in condensers, feedwater heaters and heat exchangers, the value is usually taken as what is known as the logarithmic mean. This is given by the expression:

$$M.T.D. = (D_1 - D_2) \div [\log_e(D_1 \div D_2)]$$

Where D_1 is the initial and D_2 the final temperature difference between fluids for either parallel or counter flow action. As pointed out by Brian M. Thornton in Engineering of London, England, the expression involves assumption that, at each point, heat transmission is proportional to temperature difference and that no heat is transmitted from hot to cold end of heating surface but such errors as are involved are negligible.



MEAN TEMPERATURE DIFFERENCE CHART FOR HEAT EXCHANGING EQUIPMENT

Since use of the expression for mean temperature difference involves some bothersome calculation, Mr. Thornton presents a chart for finding it direct. Either of the outer scales may be used for D_1 and D_2, a line joining the values cutting the middle line at the value of logarithmic mean difference. Values for D_1 and D_2 from 5 to 100 are shown but the chart may be used for greater differences. If D_1 is 140 and D_2 is 60, dividing by 2 we have $D_1 = 70$ and $D_2 = 30$. For these, the mean difference as shown is 47.25 and multiplying this by 2 gives 94.50 as the mean difference for the original values. Readings from the chart as shown will be accurate to half of one per cent.

ELIMINATION *of the* DISCONNECTING SWITCH HAZARD

By John Auchincloss
General Electric Co., Phila.

▼ ▼ ▼

IN THE DAY of the single-pole, hook-operated disconnecting switch, many situations arose in which the lack of a suitable auxiliary switch was sorely felt in the adaptation of protective and safety measures. The problem of insulating the auxiliary switch from the blade potential did not offer any very satisfactory solution; operation by means of rods was expensive and cumbersome and these disadvantages were of course magnified three-fold in order that the full effect might be secured on the usual three-phase circuit, for the position of an auxiliary switch on one blade only afforded no reliable indication of the position of all three blades. Chiefly on account of these disabilities, many worthy safety schemes were either not considered at all, or else abandoned when the magnitude of the difficulties in the path of their development was fully recognized.

The arrival of the group-operated disconnecting switch on the other hand, has opened up a field for the exploitation of interlocks and precautionary measures whose extent has apparently hitherto escaped the attention which it would appear to merit.

For example, the position of the switch may be supervised at all times by means of indicating lamps, thus affording a much greater measure of safety than is possible with the present mimic switch. In fact the mimic switch, because of its lack of actual association with its major member, may introduce a potential hazard in the operation of the station which is not generally appreciated.

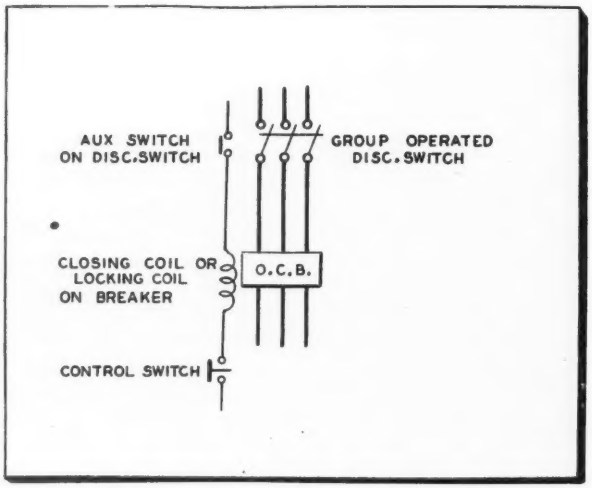


FIG. 1. DIAGRAM SHOWING USE OF LOCKING COIL ON DISCONNECTING SWITCH

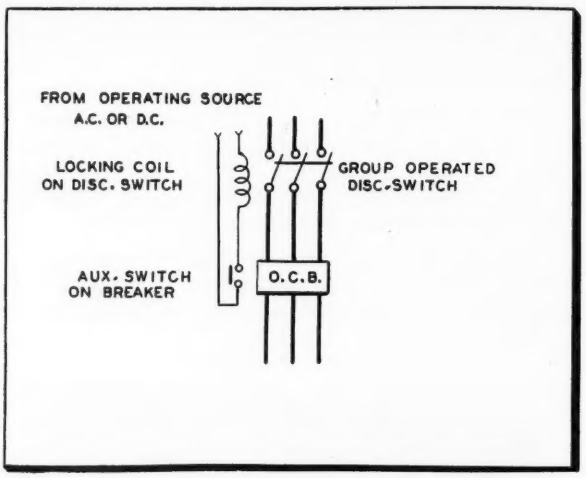


FIG. 2. DIAGRAM SHOWING USE OF LOCKING COIL ON OIL CIRCUIT BRAKE

Again, by means of auxiliary switches and magnetic locks adapted to disconnecting switches, these switches may be securely interlocked against each other, as in the case of selector switches on a multi-bus system, or, to assure correct sequential operation, they may be interlocked with their associated circuit breakers in a variety of ways almost too numerous to capitulate. In fact, the introduction of the group-operated switch has opened up the possibility of obtaining a degree of safety in operation which has hitherto been inherent only in the circuit breaker itself.

Of the many applications however there is one which were its possibility more generally known the writer feels would meet with wide-spread adoption. The hazard attending the opening of a disconnecting switch under load is universally appreciated but so far little has been done to render its occurrence dependent upon any other factor than mere care on the part of the operator. By the method illustrated in Figure 1 however it will be apparent that regardless of the state of mind of the operator, whether he is confused during an emergency or not, it is impossible for him to open the disconnecting switch until the oil circuit breaker has first been opened. As will be seen from the figure this protection is afforded by a magnetic lock on the mechanism of the disconnecting switch which is controlled by an auxiliary switch on the mechanism of the circuit breaker. When the circuit breaker is opened its auxiliary switch also opens: this in turn deenergizes the coil on the disconnecting switch thereby releasing the lock and permitting the switch to be thrown to the open position.

WHEN INSTALLING new distribution transformers it is well to set them up in their permanent locations and fill them with oil even though they will not be put into service for some time. If this is not convenient they should be stored in a dry place having no rapid or radical temperature changes, and if possible, immersed in dry transformer oil. Distribution transformers should not be stored or operated in the presence of corrosive gases, such as chlorine.

Saluda River Now Develops 222,600 Hp.

New Plant Near Columbia, S. C., Has World's Largest Earth Dam, Four 55,650-Hp. Water Wheels and Unusual Control Features

SALUDA RIVER hydoelectric development of the Lexington Water Power Co., near Columbia, South Carolina, including the world's largest earth dam in cubical content, is now in operation. This development, which has attracted engineers from all parts of the world, was described, with details of method of constructing the dam, in the March 15, 1929, issue of Power Plant Engineering.

The dam contains 11,000,000 cu. yd. of earth fill. It is 208 ft. high, nearly a mile and a half long and a quarter of a mile thick at the base. The crest is 25 ft. wide. The dam forms a lake 41 mi. long and 14 mi. wide at its widest point. The lake covers approximately 76 sq. mi. of land and has a shore line of 520 mi.

Dam alone covers 105 acres. The general scheme of development called for first laying on bed rock, parallel to the river, four 16-ft. diameter penstocks and one concrete arch conduit approximately semi-circular in cross section and 48 ft. in diameter inside. Penstocks are of plate steel completely encased in concrete having a maximum thickness of about 4 ft. The earth dam was then placed on top of these conduits and they served to take care of water during construction. After the dam had been carried high enough so that the penstocks were no longer needed for the above purpose, work on the power house was started and the pipes extended to connect with the turbines. The 48-ft. arch conduit was continued in use as a bypass for the water, when necessary, until the work reached a stage where surplus flow could be passed over the regular spillway.

Four concrete intake towers with steel reënforcing, each 30 ft. in diameter and 223 ft. high serve the penstocks. A fifth tower, 60 ft. outside diameter and 223 ft. high serves the concrete arch conduit and provides for two additional steel penstocks.

At the bottom of each of the smaller intake towers, on the upstream side, are trash racks 75 ft. high. Inside the racks on the center line of the tower are a pair of Broome roller gates for cutting off the flow of water to the penstocks. Each pair of gates is operated by a 234-t. hoist, capable of lifting them with the pressure unbalanced, although as a precaution, a bypass has been provided for first filling the penstock. The hoist is installed in a brick building on top of the tower.

In the larger tower, which is designed to serve two future penstocks, six gates of similar construction have been placed around its periphery about 100 ft. above the base of the tower.

The trash racks around the towers extend upwards 70 ft. from the bottom of the gates. Each gate is operated by a 40-t. hoist connected electrically to the hoist diametrically opposite to it.

All the above-mentioned gates can be operated from the power house through remote control. Access to the hoists is by a passenger cableway several hundred feet long from the dam to the large tower.

The spillway section across a gully 500 ft. from the south end of the dam is equipped with four Tainter gates, each 37 ft. 6 in. wide and 25 ft. high. Discharge from the spillway enters the river channel about three-quarters of a mile below the power house. The spillway in connection with the reservoir capacity, without any water passing through the penstocks or diversion tunnel can take care of a flood of 150,000 cu. ft. per sec.

Further flood safety factor is the fact that the dam is carried considerably above the normal operating level of the lake. Under extreme flood conditions, the level will not rise to within 7 ft. of the crest of the dam.

Two surge tanks, 38 ft. in diameter and 219 ft. in overall height, each having a capacity of about 800,000 gal. of water, were erected adjoining the power station

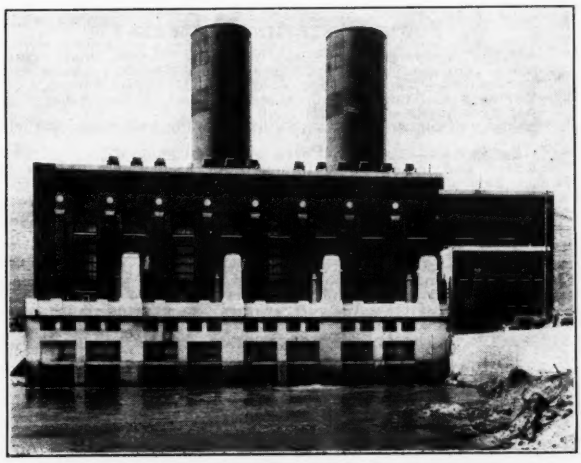


FIG. 1. EXTERIOR OF SALUDA RIVER POWER HOUSE SHOWING SURGE TANKS ON PENSTOCKS OF TWO UNITS

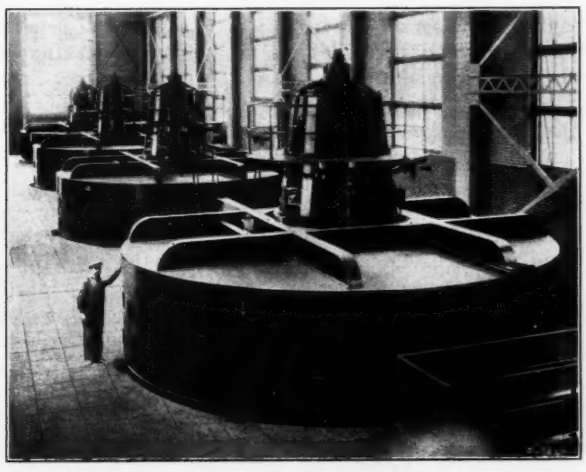


FIG. 2. FOUR 40,625-KV-A. WATER WHEEL GENERATORS AT SALUDA

to enable close speed regulation to be maintained on two of the units. The other two units will not be equipped with surge tanks unless experience shows that they are required.

The power station, of concrete, steel and brick, is designed for 200,000 kw. capacity and the present installation is 130,000 kw. Penstocks connect to 16-ft. diameter, motor-operated, butterfly valves at the power house. Each valve has a 24-in. bypass pipe and motor operated gate valve to equalize the pressures on the two sides of the butterfly valve before opening it.

Four turbines of the vertical shaft, Francis type, each developing 55,650 hp. at full gate at 180 ft. net head, rotating at 138.5 r.p.m. Scroll cases are of plate

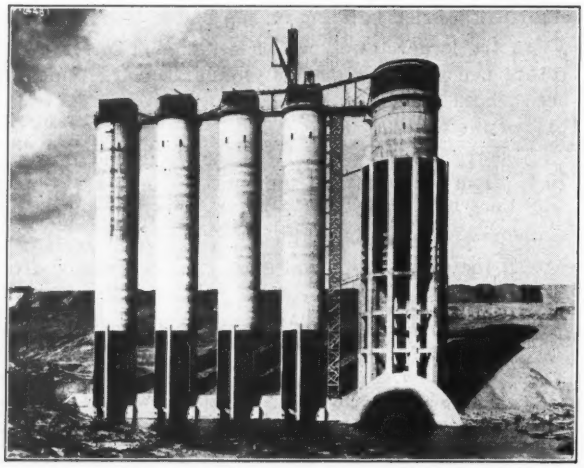


FIG. 3. FOUR INTAKE TOWERS FOR PENSTOCKS AND LARGER TOWER FORMERLY USED AS BYPASS BUT LATER TO CONTAIN TWO PENSTOCKS FOR FUTURE UNITS

steel and the draft tube is an elbow type tube, with a long horizontal part. Each generator has a capacity of 40,625 kv-a. at 0.8 power factor, is wound for 13,800-v., 3-phase, 60-cycle current and is equipped with a 250-kw. direct connected exciter and a 35-kw. pilot exciter. Generators are of the single-bearing, overhung-rotor type, having a thrust and steady bearing in the same oil pot beneath the rotor. This construction enables a rotor to be removed to give access to the windings without disturbing the thrust bearing. It also keeps all oil beneath the rotor and precludes the possibility of leaking oil being thrown into the windings.

Provision has been made for testing the units by the salt velocity method. Four piezometer taps near the entrance to the scroll case will be connected into a header which will be carried to the control room where a mercury column pressure gage is installed. This gage will register the pressure head at the entrance to the turbine and will furnish a means of determining the losses in the penstock, as well as the head on the units. In addition to the piezometer at the scroll case entrance, taps have been provided for measuring the flow through the units in accordance with the Winter patents.

In one of the intake towers is a recording head water gage of the float type with Selsyn motors for remote indication of the head water level. A similar gage is located in the tailrace of the plant. The remote indicators are in the power house control room.

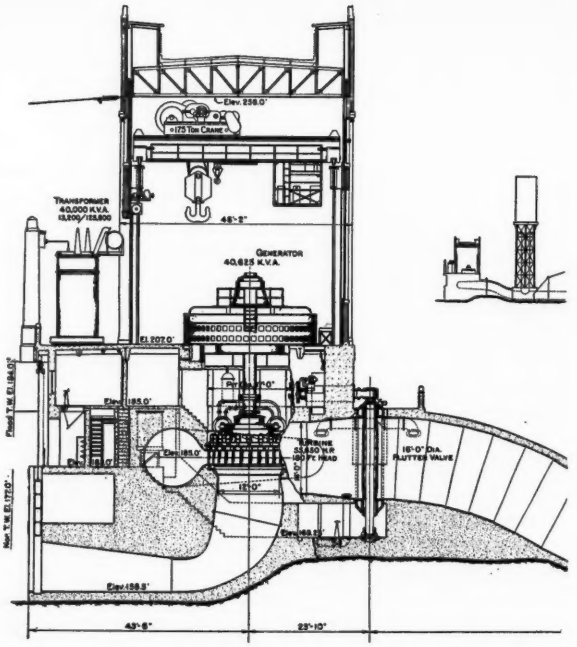


FIG. 4. CROSS-SECTION THROUGH SALUDA POWER HOUSE

There is a Woodward type A actuator for each unit and a main oil pressure tank for each two actuators. In addition, an auxiliary or reserve pressure tank for each two actuators is provided as a subject for hand control of the gates and is supplied from the pressure line through a check valve. There are two oil pumps for each pair of units, each pump sufficiently large to supply both units, under normal conditions. One pump of each pair will be operated as a preference pump.

Detailed Data on Equipment at Saluda River

Contracts

General contract—W. S. Barstow & Co., Inc.
Clearing work and installing station equipment—W. S. Barstow & Co., Inc.
Construction of dam—The Arundel Corp.
Erecting intake towers—McDonald-Spencer Slipform Co. (sub-contract).
Fabrication and erection of steel pipe penstocks—The Reeves Bros. Co.

Power Generating Equipment

Station equipment including induction motors, main transformers, cam switches and limit switches—General Electric Co.
Generators—Westinghouse Electric & Manufacturing Co.
Turbines and main pivot valves—S. Morgan Smith Co.
Air vent pipes—W. K. Mitchell Co., Inc.
Bypass discharge piping—National Valve and Manufacturing Co.
Gate valves—Chapman Valve Manufacturing Co.
Gates and hoisting equipment and steel pipe linings for water passages—Phillips & Davis Manufacturing Co.
Miscellaneous iron and steel—Carolina Steel and Iron Co.
Miscellaneous steel pipe, bolts and gaskets—Benjamin F. Shaw Co.
Protective material for miscellaneous steel—Detroit Graphite Co.
Protective materials for steel—Wailes-Dove-Hermiston Corp.
Shop and mill inspection of pipes, concrete tests and inspection of structural steel and vent pipes—Albert W. Hunt Co.
Structural steel and steel racks—Belmont Iron Works.

Engineering

Supervisory engines—Murray & Flood.
Resident engineer—Arthur W. Wellwood.
Consulting hydraulic engineer on development—Albert S. Crane.
Design of dam—J. G. White Engineering Co.
Chief construction engineer—A. P. Campbell, W. S. Barstow & Co.
Superintendent of construction in field—N. D. Urquhart, W. S. Barstow & Co.

With two of the units to be operated without surge tanks, it is necessary to regulate the rate of closure of the turbine gates so that there will not be an excessive pressure rise in the penstocks. For maximum assurance against tampering, this is to be accomplished by means of a diaphragm and orifice in one part of each servomotor.

The method of control of the unit contemplates practically complete control from the control room by the station operator.

In the interest of simplicity, each generator is directly connected to its transformer by disconnecting switches and all switching is done on the high tension side of the transformers. The substation is located a short distance away from the power house, with all equipment outdoors, except for relays and switches, which are located in a small control house. There are five outgoing 114-kv. circuits. All switches and relays have supervisory control. A carrier telephone system is used for dispatching the load.

The output of the station is expected to average about 360,000,000 kw-hr. per year, of which 300,000,000 kw-hr. has been sold at the high tension bus to the Carolina Power & Light Co. and the Duke Power Co. These companies have constructed their own 114-kv. transmission lines for receiving the power. The remainder of the output will be taken by the Broad River Power Co., which is also prepared to furnish such steam energy as may be necessary during an extremely dry period to make it unlikely that there will be any shortage in the energy placed on the transmission lines of the other companies.

Economical Small Ice Plant Operation

REFINEMENTS WHICH COST LITTLE CHANGE OPERATION FROM LOSS TO PROFIT. POWER CONSUMPTION SHOULD NOT BE OVER 40 KW-HR. PER T. BY RUDOLPH SOMMERS*

WHEN the machinery builders complete the erection of a plant, the final adjustments are made throughout the plant and from then on, the efficiency of the plant depends largely on the type of man placed in charge of operation. If possible, a competent man who is capable of making recommendations to the owner for necessary changes in the plant equipment should be selected, as new discoveries are made every day in the field of refrigeration. We have plants which were built years ago in which the mechanical equipment has been kept up to date and some of these plants rank today among the lowest cost producers and will compare in efficiency with many new plants built.

Some plants are being operated mostly from the standpoint of daily routine and with little consideration given to the actual performance of the mechanical equipment. Frequently the engineer in charge of operation accepts the working of his plant as being satisfactory because production was much better than the year before. But that does not relieve the engineer's responsibility for the high power consumption; the large amount of water consumed and the high cost of manufacturing sundries which all make up the cost per ton of ice, unless of course he can reasonably explain the cause.

Owners should assist the engineer in charge, by providing various recording charts which will assist the engineer to better and more economical operation. It is also important to provide the engineer with a chart showing the various water temperatures and the corresponding theoretical ammonia pressures so he can compare the water temperatures coming off the ammonia condensers and the ammonia pressure in the condensers. Plants, where the purging of air and noncondensable gases is being well taken care of will not vary over a 2-lb. difference from the theoretical. We have several plants in operation now where we run with 2 lb. or less pressure difference. Plants which have not been equipped with gas purifiers should install them and derive the benefit in power saving.

*Vice President of the Boston Ice Co., Boston, Mass. From an address delivered before the Third Annual Convention of the New England Ice Dealers Assn.

POWER SHOULD BE 40 KW-HR. OR LESS PER TON

A few years ago, engineers predicted that plants would be built in the future with a power consumption of 40 kw-hr. per t. on a yearly average. Today it is not considered good engineering if the power consumption is above 40 kw-hr. per t. and much better records have been established in carefully laid out plants. A plant using a spray pond or cooling tower with the proper equipment installed for recovering all waste water should not use over 45 cu. ft. per t. of ice, based on a yearly average. At the prevailing rates in Boston, this amounts to about 7.5 cts. per t. of ice.

It is very important that the harvesting of ice from the freezing tanks is done on time schedule. More modern plants have installed recording charts showing the exact time when each row is filled with water. This is helping to keep the brine temperature constant and to increase production. The engineer in charge should work out a schedule fixing the time to be allowed between each harvest.

Plants where forecooling water to cans has been omitted, will find it beneficial to have a forecooler installed, as it will materially help to decrease the freezing time and in some cases where the brine temperature is carried low it will help to some extent to eliminate core shatters in ice.

One of the most important arrangements in the plant is the ammonia controls to the freezing tanks. All up-to-date plants have been equipped with suitable ammonia liquid float controls, which keep the brine cooling system constantly full of ammonia and thereby derive the full benefit of the total cooling surface in the brine tanks. In the type of system where shell coolers are in use for cooling brine, it is advisable to install an ammonia liquid level indicator, which shows the exact amount of liquid being carried in the freezing tanks at all times.

A great saving has been obtained by installing ammonia liquid precoolers. This is generally arranged in two principal methods. One arrangement is to precool the ammonia liquid in the same coils where the water to cans is cooled under high back pressure. From this evaporator a line is connected to the center port on horizontal compressor to a dual-effect compressor—if available, or, if the plant has several compressors, one compressor is generally connected to work on high pressure. The other method is to install a separate liquid precooler, which consists of a drum connected to a float control, regulating a constant height of liquid to be carried in the drum. The cold liquid flows by gravity to the brine cooling system and the gas is carried from this evaporator in a separate line and connected as in the method already mentioned. Plants where these systems have been installed, have not only increased their capacity in production, but have decreased the power consumption with a large saving. This should be of vital interest to the plant owners, if the cost of production per ton of ice is to be lowered.

Every engineer admits that water should be run through filters before entering the cans to remove some of the heavy sediment in water. Others have felt that this is not sufficient and have installed alum pots alongside of filters to feed a certain portion of alum directly into the water to be filtered. This has been a considerable help in removing a certain amount of the discolored and organic matter from the frozen water. Systems of this type have their drawbacks, as it has been proven in most cases where this kind of treatment is used, a considerable amount of ice will be harvested with a heavy yellowish core when the air lines have stopped blowing or if the cores have not been properly pumped out.

The most reliable method known today is to treat and filter the water before it is sent to the cans. This is accomplished by erecting a wooden tank with chemical and water apparatus set to feed the water and chemicals at constant fixed proportions. The precipitation takes place in the tank and all discolored and organic matters in the water are brought down to the bottom of the tank and disposed of to waste. The clean water from the top is sent through the filter to fill the cans.

To those of us who are confronted with the problem of maintenance and mechanical depreciation reduction, the formula, which the A.S.R.E. Corrosion Committee contributed to the trade, has proven of vital importance in treating brine against corrosion. We have plants in which the brine was treated with sodium dichromate several years ago and their equipment and the galvanizing on the ice cans are in the same excellent condition as the day when they were placed in service. The treatment is very inexpensive and can be handled by any competent man in your plant.

MODERNIZATION of a plant to use power to best advantage should increase output per worker, raise the worker's wage and lower cost of the product. It is based on capital expenditure to reduce cost while increasing the worker's pay. An example is a $100,000 special tool in a Diesel Engine Co.'s plant to combine three operations at one set-up. A large electric motor will double the output of the man operating it and justify higher pay to him, but will lower the cost of the engines and make for larger sales, thus increasing the number of workers employed.

Small Boiler Tests

BOILER TESTS of more than passing interest to small boiler operators were made by Paul Bucher, Professor of Steam Engineering and Professor Roberts of Ohio State University, on a 45-hp. Leffel Scotch marine boiler fired by an underfeed stoker.

Burning 264 lb. per hr. of Logan County (W. Va.) 1½-in. nut and slack coal with a heating value of 13,989 B.t.u. per lb., the equivalent evaporation was 10.08 lb. and the overall efficiency 69.9 per cent. The boiler had been in use four years and was somewhat scaled up and this may have reduced the efficiency somewhat.

During the 12-hr. test, the pressure averaged 101.4 lb. ga., the steam quality 99.3 per cent, the rating 171 and the CO_2 14.28 per cent with 24 per cent excess air. Flue gas temperature increased from about 600 deg. F. at the beginning of the test to a little over 700 deg. F. at the end with an average of 671 deg. F.

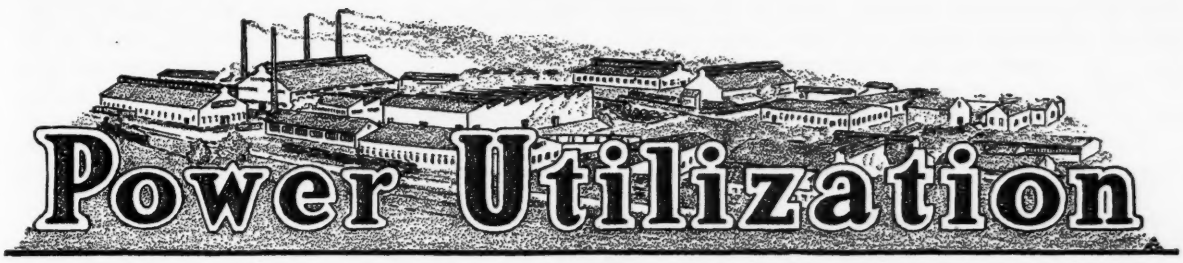
Heat balance calculated percentages per pound of coal fired are as follows: Absorbed by water, 69.9; loss due to moisture in coal, 0.1; loss due to hydrogen, 4.2; loss due to dry flue gases, 13.8; loss due to incomplete combustion, 0.2; loss due to combustibles in refuse, 1.3; loss due to moisture in air, unconsumed hydrogen and hydrocarbons, radiation and unaccounted for, 10.5.

Before starting the test, the boiler was operated two hours continuously so as to have the usual running start. The fire was cleaned twice, the last time 1 hr. 55 min. before the test was terminated so that the water and fuel bed were in the same condition at the end as at the beginning of the test. During the two cleaning periods, No. 2 Ringlemann smoke lasted for about 90 sec. and this was the only time noticeable smoke was observed. The fireman leveled the fuel bed with a hook about every 40 min.

The boiler and stoker of the type is built in small sizes and forms a compact unit. The boiler heating surface is made up of 3-in. tubes, 114 in. long and the combustion space is 64 cu. ft. which, with a projected grate area of 13.3, gives 4.81 cu. ft. of combustion space per square foot of grate area. At the average rate of 264 lb. of coal per hour, the stoker handled approximately 20 lb. of coal per square foot of grate area and the heat release per cubic foot of furnace volume was in the neighborhood of 57,500 B.t.u. During the first cleaning period, 126 lb. of refuse was removed in 7 min., the second time 98 lb. was removed in 5 min.

PRODUCTION OF ELECTRICITY by the electric light and power industry of the United States for the week ended Saturday, July 4, was 1,575,780,000 kw-hr., according to the Statistical Research Department of the National Electric Light Association. Because of the Independence Day holiday on Saturday, this was somewhat less than the week before. It is 2.8 per cent below the corresponding period of last year. Statistical comparisons are of little value in this instance, however, because in 1930 the holiday included both Friday and Saturday.

The Atlantic seaboard shows an increase of 3.8 per cent in electrical output above last year. The great central industrial region, outlined by Buffalo, Pittsburgh, Cincinnati, St. Louis and Milwaukee, registers, as a whole, a decrease of 1.9 per cent, although the Chicago district shows an increase of 5.5 per cent. The Pacific Coast shows a gain of 0.4 per cent from last year.



Anti-Friction Bearing Application

By A. K. West

LONG EXPOSURE to the evidence has made the industrial public quite familiar with the benefits of anti-frictionization. Some sides to the matter may not be so familiar, however, but have a decided bearing on the degree to which the benefits can be realized. One of the most important of these is proper bearing application.

In the case of new machines, this particular business can, of course, be left with perfect confidence to the manufacturer of those machines. But a policy of anti-frictionization need by no means imply only the installation of new machines. On the contrary, many an existing machine, whose economic record is not too good can be, other things being equal, put back on its feet by providing it with a set of anti-friction bearings. So the subject of their proper application is of more general interest than might be suspected at first thought. Even in the case of new machines that arrive fully equipped, a little knowledge of the principles back of the bearing mounting methods employed hardly comes amiss.

It is manifestly impossible to go into detail about all the facts involved in making applications of anti-friction bearings. Practically every machine and, for that matter, every shaft on every machine is an individual problem that must be settled on its own merits. But, as far as Timken bearings are concerned at least, long experience in making applications to a great variety of machines has brought about what may be called the crystallization of some fundamental principles. They are so fundamental in fact that most of them will apply equally to every case and some of them to every case in a few definite classes. For, as far as bearing problems are concerned, all machines, regardless of function, can be placed into one of a few definite classes, the determination being largely one of operating characteristics.

In many cases, the basic design of the mounting is almost standardized to fit the requirements. Or, perhaps a better way of putting it would be to say that mounting arrangements have been developed that will meet a set of given conditions in any machine where they exist. Probably the best way out of an explanation that is rapidly becoming more involved than the situation it is intended to explain would be to give some concrete examples. And, to be logical, the argument will progress from the general to the particular.

In the beginning, it was said that some general principles apply in every case of bearing application. The most important of these, unquestionably, is accuracy in load determination. How important it is may be gathered from the statement that trustworthy statistics show that by far the majority of bearing failures in service can be traced directly to avoidable overloading. By that is meant simply overloads, either sustained or intermittent, that were not taken into account in the original selection of the bearings. Such loads may and do arise from any one of a number of causes. Change in the material on which a machine is working may cause sustained overloads, as may an attempt to increase its volume of production, either by crowding material or increasing the speed. Or, again, a machine may be installed where surrounding temperature conditions, not foreseen by the builders, are sufficient to cause an increase in some of the loads. These examples are given mostly to bring out the necessity for taking every factor, no matter how apparently trivial it may be, into account when determining loads. They are especially applicable when machines are to be changed over, or anti-frictionized because, in such cases, the loads as originally calculated by the manufacturers may not be a safe guide for the selection of new bearings to meet conditions as they actually exist.

Many simple and accurate methods of determining loads can be applied under actual running conditions, so that every factor will be automatically taken into account. One, that is particularly valuable in the case of steel rolling mills, or rubber mills, or other exceptionally heavy duty machines, is called for convenience the pressure method. A number of special instruments have been evolved, but the simplest are the Brinell method and the hydraulic cylinder. In the Brinell method two hardened steel plates, one smooth, the other recessed for balls, with hardened steel balls between them are put between the bearing chuck and screws or backing up member of the machine. The parts are then set for normal production and the test started. The depth to which the steel balls are driven into the smooth plates serves to indicate the load pressure encountered. One difficulty is that this load is cumulative, that is, it shows only the maximum, or peak load. No idea of the sustained load, or the duration of the peak load can be obtained. The other method consists of the insertion in the machine of a hydraulic cylinder, Fig. 1 connected to a recording pressure gage, that can be calibrated in pounds of load. This has the advantage of showing the maximum loads, also the sustained loads and the duration of what peaks do occur; in fact it gives a complete and easily analyzed picture of the

whole load cycle of the machine. Although these methods were developed primarily for heavy duty machinery, it is a simple matter to modify them, especially the latter, for use in many types of medium to light duty machines.

In case these methods are impractical, others, while less complete, perhaps, in the data supplied are sufficient safe in most cases, is founded on the superstition that, if the bearing is big enough to fit over the shaft, it will just naturally have enough capacity to carry the load. The danger of this theory is in the things it fails to take into consideration, such for instance as unsuspected thrust loads, either intermittent or otherwise, the superimposed loads caused by shaft expansion, shocks, vibra-

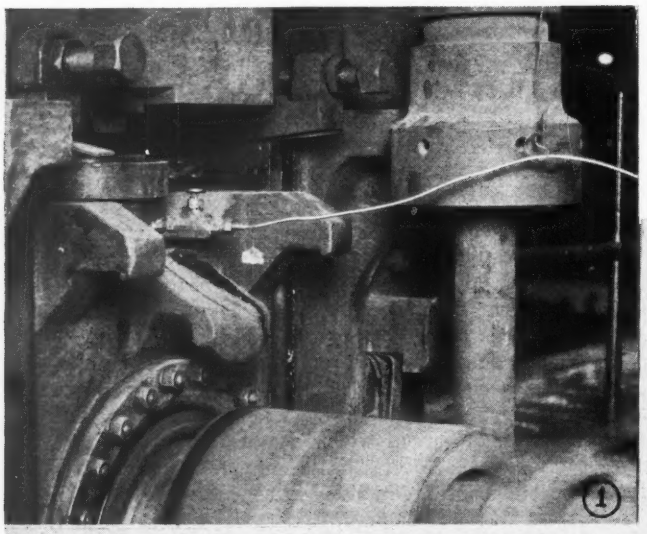
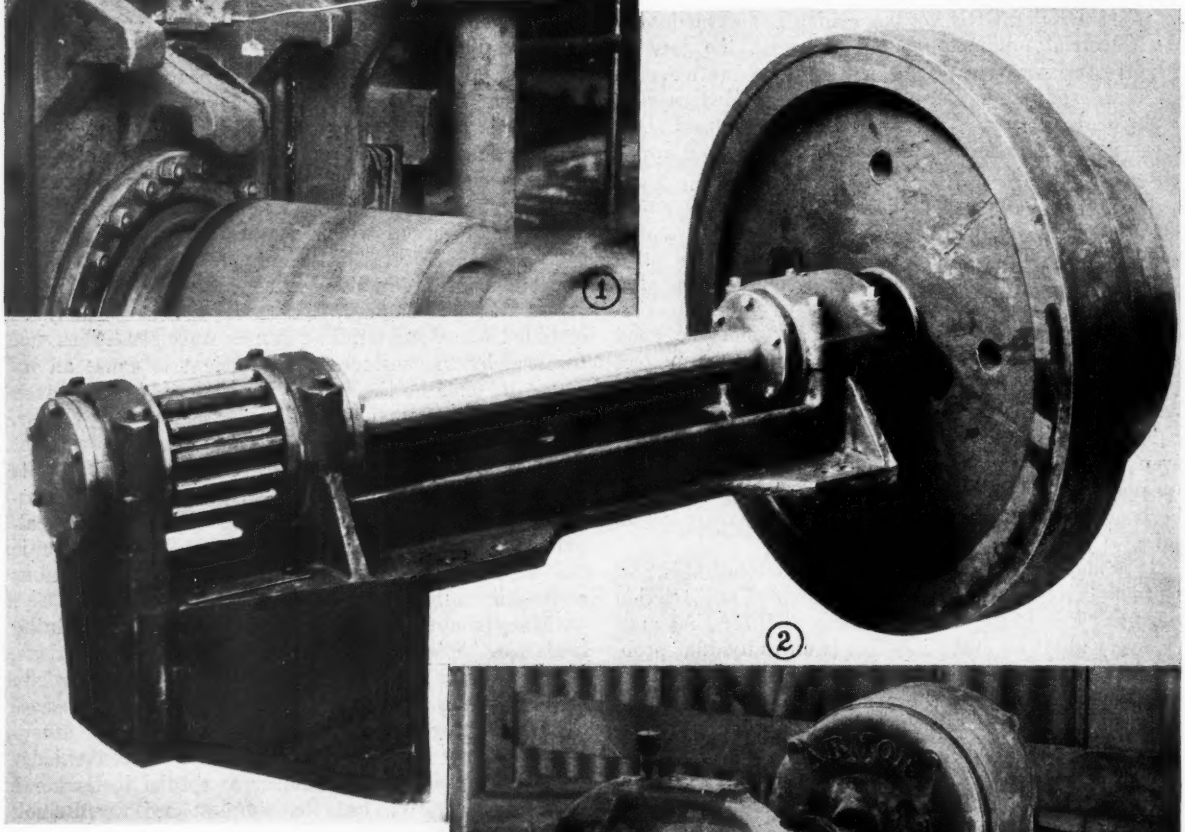


FIG. 1. HYDRAULIC CYLINDER TO SHOW PRESSURES ON STEEL ROLLING MILL BEARING

FIG. 2. INDIRECT MOUNTING OF DOUBLE BEARINGS WOULD BE USED HERE



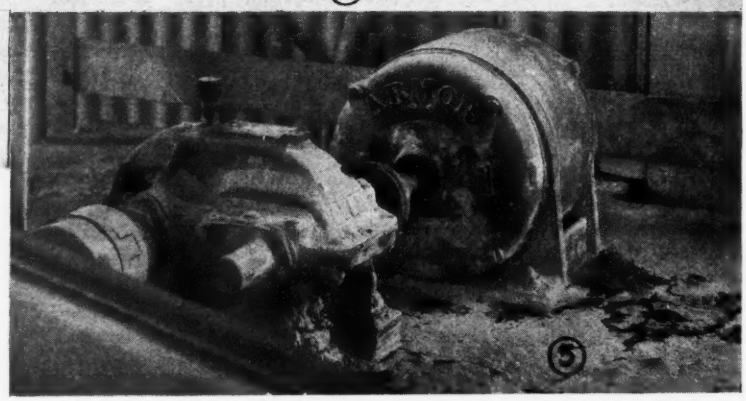


FIG. 5. TIGHT ENCLOSURE OF ANTI-FRICTION BEARINGS IS ESSENTIAL HERE

unto their ends. For example, if a machine is electric motor-driven, curve-drawing instruments in the motor lines will often give an indication of both the volume and duration of the loads, especially peak loads. Or where speeds and the weight of moving parts are known and the machine load characteristics are fairly simple, the load values can be calculated by standard formulas.

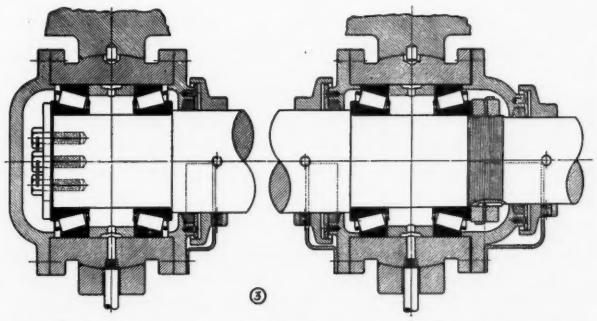
One method sometimes used, that is not particularly tion, or other possible conditions. Therefore, except perhaps in the case of quite simple applications, such a rule should seldom be trusted and, even in these, a little more time spent in obtaining accurate data will usually pay in the end. In fact, to sum up the whole business, the importance of gathering meticulous information on every phase of loading in every case cannot be readily overestimated.

Next in importance to proper load determination comes fitting practice. For general purposes, fitting practices have been so boiled down that a few general rules cover most cases. Of course, there are always the exceptions, made up of special problems when the conventional methods will not fit. In dealing with them, the best procedure is consultation with the manufacturer of the bearings. For the common run of Timken applications, however, the following simple rules are a perfectly good basis for design. In dead-shaft, low-speed mountings the inner races of the bearings are usually given a light fit on the shaft and the outer ones pressed into the housings. As the speeds and loads increase, the fit of the inner races on the shaft should become progressively tighter. When the conditions are reversed, that is, the shaft rotates, the inner races are given a press fit on the shaft, and the outer ones a light fit in the housing. Heavy duty machines, or those where there are severe shock or vibratory loads, form an exception to these rules. In such cases both inner and outer races should be given fits tight enough to eliminate any possibility of bearing creepage.

Another factor in the application of Timken bearings well worth consideration is the matter of direct or indirect mountings. This applies particularly when the design calls, as it often does, for the use of two bearings in a box. In the direct mounting the larger ends of the bearing rollers face each other, in the indirect it is the smaller ends of the rolls that face. The choice between the two mountings is determined mostly by the load and speed requirements to be met, although of course at times other factors may also have some effect. The direct mounting is recommended where bearing centers are comparatively far apart, and, as a general thing, on live shafts. The indirect mounting is recommended where bearing centers are comparatively close and generally for stationary shafts. The indirect mounting is always to be preferred if specially heavy thrust loads are to be carried, irrespective of either speeds, or whether the shaft is live or stationary. A typical example of such a case would be an overhanging load such as that imposed by an outboard gear, or flywheel, Fig. 2.

On the subject of bearing mountings, one other point is the matter of making provision for floating the shaft, to take care of shaft expansion, of inaccuracies in machining, or both. This particular problem is often met in machines that are subject to hard service or where the shaft, or rotation member supported by the bearings is likely to undergo temperature variations. The variations may be normal, as in the case of heated mill rolls of various kinds, or they may be abnormal, arising from work being done, or the surrounding temperatures. In either case, both the remedy and the result are much the same. The bearings in one box are fixed to provide the necessary location of the shaft and those at the other end are mounted so that the outer races float in the box. Floating may be accomplished in any one of several ways. The cups may be given a loose fit in the housing as at the left in Fig. 3 and sufficient end clearance be left to permit longitudinal movement in both directions or the cups may be mounted in a cartridge, or container, which itself floats in the housing. The choice of methods depends entirely on the general design requirements of the particular case in hand as both are equally effective in accomplishing the desired result.

Two other precautions, if they may be called that, worth attention are providing for self-alinement and ease of disassembly. The former is quite general, the latter less so but still does come much to the fore in certain classes of machines. Rendering the bearings self-alining is fairly simple. Usually it is accomplished either by crowning the box, and giving the supports a straight cylindrical bore, or by using a ball and socket arrangement between box and support as in Fig. 3. Some such arrangement is useful in the case of long shafts that have a tendency to whip between supports, or revolving parts that are subject to deflection under load. It is also helpful to compensate for inaccuracies in leveling when machines are installed. The second point, ease of disassembly, is rather special but it does arise often enough to be worth consideration. It applies particularly to machines having parts that must be taken out occasionally for reconditioning, such as circular saws, pulp grinder wheels in paper mills and similar devices. As usual, there are several ways of meeting this particular requirement. One is to mount bearings having a tapered bore on a tapered sleeve, or adapter, that fits over the shaft. Since the adapter bore itself can be ground to fit any shaft diameter, this method is especially applicable when bearings are to be installed in an existing machine. Or, the construction may be varied by using straight bore bearings on a tapered bore adapter, the shaft being tapered to fit, Fig. 4. Finally, tapered bore bearings are used on a tapered shaft, the arrangement at least having simplicity to recommend it. In all cases, the whole bearing assembly



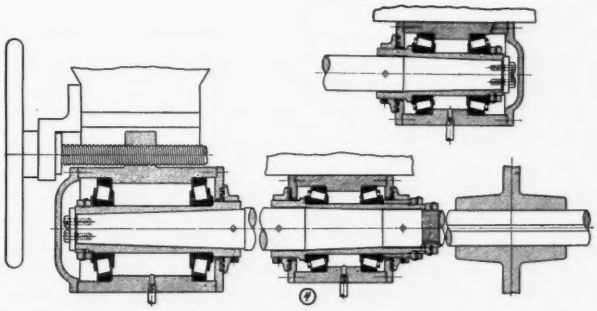


FIG. 3. SHAFT EXPANSION IS CARED FOR BY ALLOWING OUTER RACES AT LEFT END TO MOVE IN THE BOX
FIG. 4. THIS MOUNTING IS FOR EASE IN DISASSEMBLING

can be pulled off the shaft without disturbing the set-up of the bearings themselves.

Since lubrication plays a large part in bearing performance, enclosure design is important in bearing application. If it is hard to formulate general rules covering other features of bearing application, it is impossible to do it for enclosure design, since there are about as many different forms of enclosure as there are bearing mountings and they range all the way from extremely simple to extremely elaborate. If one must generalize, it is safe to say that the enclosure design is governed largely by the consistency of the lubricant used, the speed of operation and the surrounding conditions as to prevalence of dirt and moisture. This can be simplified even further: Any form of enclosure that will keep the lubricant in and the water and dirt out under the existing operating conditions will meet the design requirements, Fig. 5. Several more or less standard enclosures have been developed for use with roller bearings under different operating conditions that are founded on these two principles. They can easily serve as models for enclosure design generally. Their most prominent feature is the most inexpensive simplicity consistent with meeting the requirements.

More factors than these are, of course, to be considered when applying roller bearings. But most of them are special and apply only to specific applications. In the last analysis, they will be found to be merely variations of one of the fundamental principles that have been outlined above. Therefore, even if it were practical to describe them in detail, the propriety of doing so is questionable. To sum up the whole business, bearing application lends itself to no hasty conception, or haphazard methods. But when it is undertaken with the proper amount of care, the results will more than repay for the time and energy that are expended.

Operation of the Electric Maintenance Department*

By Sidney Watkins

ELECTRICAL maintenance offers opportunity to the technically trained man, if he is given a chance to utilize modern equipment in the solution of industrial problems. With but a few hours between raw material and finished product, failure of a single piece of equipment may result in serious loss of production. Prevention of failure is, therefore, most important and demands high standards of training and knowledge in the personnel.

Because proper installation and maintenance are essential, responsibility of the electrical department should be to some high official in the organization who understands modern requirements. "Put it where the old equipment stood and let it run until it stops" is not a proper attitude, if good results are to be obtained.

Organization

Engineering, maintenance and repairs are the groupings of the work; engineering to keep records, prepare plans and draw up specifications for new equipment, also inspection schedules; maintenance for inspection, care and such repairs and adjustments as can be made without stopping or replacing equipment; repairs for rewinding motors and major repairs requiring stopping or removal of equipment.

Records should include an up-to-date plan of all wiring with size, length and connected loads of all circuits; also for each piece of electrical equipment, nameplate data, location, length of service and repairs made. Inspection reports should be filed with these records.

In small plants, work of the different groupings may be done by the same men but for large industries they are better separated.

Location and Equipment

Equipment for inspection, testing and repairs should be adequate and modern to prevent burnouts and secure effective performance. Location should be central to permit quick service, with space enough for good working room and orderly storage of spare parts and material.

Automatic call systems have the advantages over the telephone of quick shifting of workers as needed and quick mobilization in case of emergency.

Inspection routine should be regular, based on plant conditions but taking into account that insulation resistance of motors needs testing at least every 6 mo., that controls for elevators, reversing motors on planers and like service need more attention than those where starts and stops are infrequent and that heat is an enemy of insulation, spring contacts, soldered terminals and protective devices. Hot spots need frequent inspection.

Keeping terminals and bushings free of oil and dust, oil in transformers and oil switches free of impurities, also contacts and joints clean, firm and in line is important.

To get effective work it is important that "Nobody be permitted to do electrical work except men who have been trained for the job."

*From a paper before the National Industrial Congress at Cleveland, Ohio.

**Electrical Engineer, Warner & Swasey Co.

Gas-Vapor Mixture for Heating

IN A PAPER before the American Society of Heating and Ventilating Engineers, C. A. Dunham has described a system for vaporizing water by mixing products of combustion from burning gas in a vortex refractory furnace with the water. The mixture is then led direct to radiators for heating, the condensed vapor being returned to the generator and noncondensable gases being exhausted to a flue by a small electric fan.

By this means, the water vapor serves as a medium to convey heat to distant points more effectively than would the combustion gases. It is stated that temperature at the generator outlet is reduced, while that at the radiators is increased and heat loss in flue gases is minimized. Water from combustion of hydrogen in the gas more than makes up for the vapor loss to the flue, surplus passing to an overflow drain from the generator.

Results from tests made by Experimental Laboratories, Inc., showed an efficiency of heat delivered to the radiator to heat supplied to the system of 88.4 per cent.

The method would seem applicable to house heating and for heating in industrial plants where purchased power is used.

Electro-Hydraulic Drive for Underfeed Stokers

GREAT FLEXIBILITY WITH SIMPLE CONTROL BY J. F. COOKE*

DURING the last few years, improvements have made the underfeed stoker capable of burning coal efficiently throughout a wide range in ratings, so that, when the load drops, boilers under pressure can be floated on the line at low ratings instead of banking them, reducing banking losses to a low figure. In order to take advantage of this increased flexibility, the stoker should have a drive which makes it possible to reach low ratings and to secure the many in-between ratings at which it may be desirable to run.

As an example: Suppose that stokers are to fire 600-hp. boilers whose capacities are 300 per cent maximum and 100 per cent minimum of rating; a four-speed motor would probably run 360, 600, 720 and 1200 r.p.m., 360 r.p.m. developing the 100 per cent rating. The boiler ratings corresponding to the other three motor speeds, taking into consideration the efficiency of the stoker, would be approximately 140, 160 and 230 per cent. With this motor, the high-speed setting of the power box would give boiler ratings of about 175, 250, 290 and 375 per cent. The stoker manufacturer prefers to operate over the entire range of the stoker, in this case from 100 to 300 per cent of rating, at the low-speed setting of the power box, reserving the high-speed for building up any section without having to thicken up adjacent sections.

Three disadvantages thus illustrated are: 1. inability to obtain intermediate ratings such as 150 per cent or 200 per cent without jockeying between ratings higher and lower than the one wanted; 2. inability to reach the 300 per cent maximum without using the high speed of the two-speed power box; 3. ratings lower than the 100 per cent minimum can be attained only by intermittent feeding.

Other drives, however, are satisfactory within certain limitations, such as the brush-shifting motor for alternating current and the mechanical speed transmissions. Steam turbine drive furnishes a speed range of ten-to-one and all intermediate speeds between its maximum and zero. For ordinary requirements it has been widely adopted, particularly by those plants which can utilize exhaust steam in the manufacturing processes, such as paper mills and bleacheries.

Wherever direct-current can be obtained the d.c., adjustable-speed, shunt-wound motor with field rheostat control provides a number of intermediate speeds from its minimum to maximum but requires intermittent feeding at low loads.

Wide variation in the rate of feeding coal is obtained by the Hele-Shaw hydraulic transmission which will give an infinite number of speeds within a range of 100 to 1, depending upon the size of the transmission required to drive the stoker crank shaft. It may be applied to all types of stokers, overfeed, underfeed, single or multiple retort, traveling grates or wherever engine or motor is ordinarily used. This drive consists of two separate units, designated respectively, the hydraulic pump and the hydraulic motor.

The hydraulic pump, Fig. 2, is a variable-stroke, variable-discharge, high-pressure pump, driven by a constant-speed prime mover, to deliver oil to the hydraulic motor, Fig. 3, at any required pressure, not exceeding 1500 lb. per sq. in. and to receive the oil back again as it is discharged from the hydraulic motor, thus maintaining constant circulation. Hydraulic pump and hydraulic motor are identical in design and construction, except that the motor has a predetermined fixed stroke, while the stroke of the pump may be varied at will from its minimum to its maximum.

The heart of the Hele-Shaw pump, Fig. 1, is a cylinder body whose radial cylinders discharge at a common central port, the whole revolving about a fixed cylin-

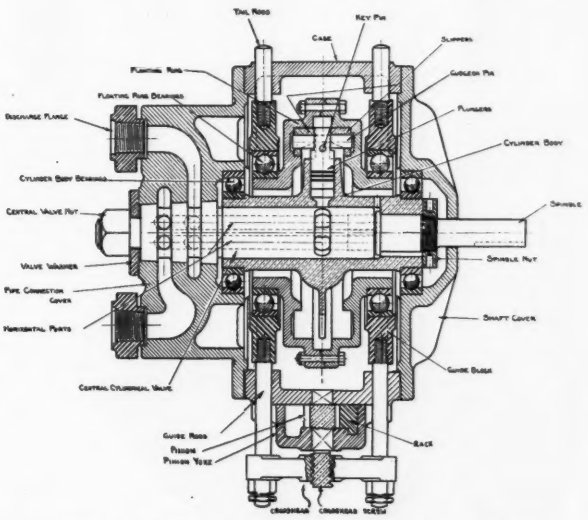


FIG. 1. CROSS-SECTION OF HELE-SHAW PUMP

drical valve containing two disconnected, parallel, longitudinal ports. The working plungers are constrained to rotate about a movable center, the position of which is determined by the hydraulic pump control. It is apparent that, if the center of revolution of the working plungers is concentric with the center of revolution of the cylinder body, the working plungers will have no relative reciprocating motion. If, however, by moving the crosshead control, the center of revolution of the working plungers is made eccentric with the center of revolution of the cylinder body, a relative reciprocating motion will be given to the working plungers, resulting in a discharge of the pump proportional to the distance one center of revolution is displaced from the other. This distance, termed the stroke of the Hele-Shaw pump, can be varied at will while the pump is running, by means of the crosshead screw, resulting in a variable discharge of oil from the neutral to full stroke positions of the working plungers. This screw is usually operated

*American Engineering Co.

by a pinion and rack, the rack being connected by rod and bell cranks to the power cylinder of the damper regulator as in Fig. 2.

It is apparent that the direction of the discharge of the pump may be reversed, for the pump is so designed that the working plungers function when their center is eccentric on either side of the fixed center of the cylinder body. This is not important for stoker operation, except where the rotary ash discharge is hydraulically driven, or the stoker is 100 per cent hydraulic drive.

Speed of the hydraulic motor depends upon the volume of oil delivered to it by the hydraulic pump. This volume depends upon the length of stroke given to the hydraulic pump; consequently, a speed of the hydraulic motor shaft may be had from zero, when the hydraulic pump is in neutral position, through all intermediate speeds, to a maximum corresponding to the full stroke of the hydraulic pump. Boiler output varying from 25 to 500 per cent of rating can easily be carried, with the exact speed required for any intermediate point always available.

With this electro-hydraulic transmission, the motor or other prime mover can have a constant speed, hence run at good efficiency, yet an infinite number of speeds can be obtained over a wide speed range. Speed control is simple, yet sensitive, with smooth action at all speeds and the pump unit of the transmission may be located at a distance from the stoker at any convenient point.

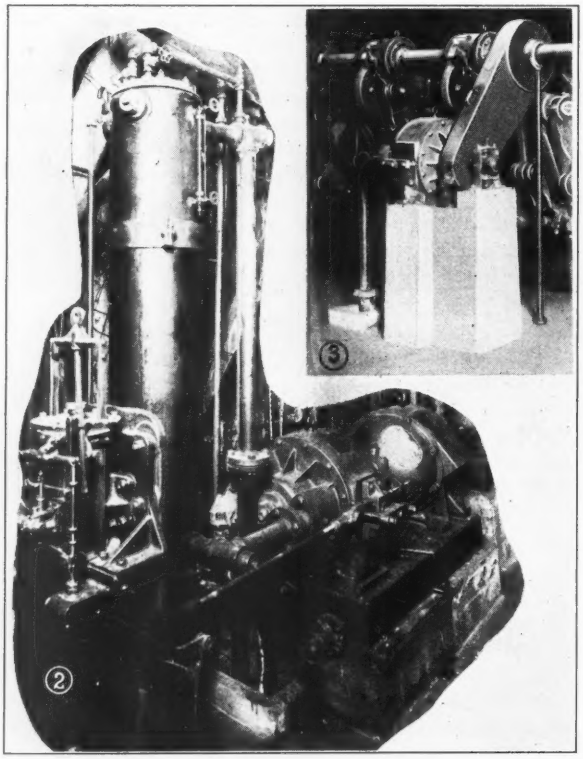


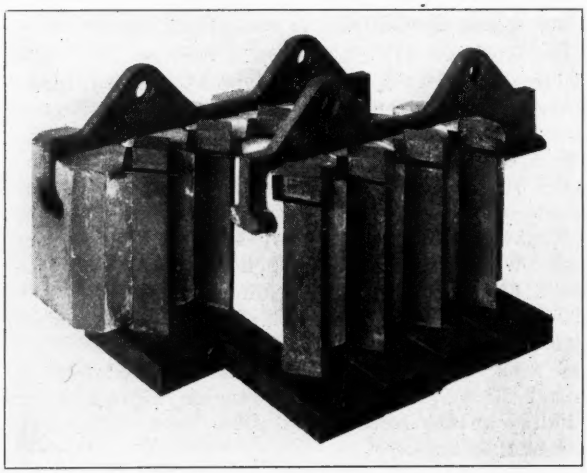
FIG. 2. HELE-SHAW PUMP UNIT AND RECEIVER WITH PUMP STROKE CONTROLLED BY DAMPER REGULATOR, IN PENNSYLVANIA R. R. PLANT

FIG. 3. MOTOR FOR TAYLOR STOKER DRIVE, AT PENNSYLVANIA R. R. PLANT

Veneer Protection for Arches

SILICON CARBIDE refractories, when properly manufactured, have the essential characteristics of high refractoriness and remarkable resistance to severe temperature changes, as well as the ability to withstand flame impingement without erosion. Their high conductivity, however, preclude suspension directly from metal supporting members because of the danger of overheating these supports.

This problem has been solved by the Carborundum Co., Perth Amboy, N. J., by transferring the support of the silicon carbide protecting facing to the outer or cool surface of the fireclay arch. This facing is constructed of simple shapes, shown in the illustration, ordinarily made to provide a facing 1½ in. thick with a support leg of proper length to extend through the fireclay arch.



ASSEMBLY OF VENEER ARCH REFRACTORIES

The fireclay portion of the arch is assembled on metal supports in the usual manner and the veneer blocks are then applied by inserting the support leg into the openings provided for them and fastening in position with metal clips. This improved form of arch construction has the following advantages: complete protection of the hot face of the fireclay arch from flame impingement and spalling caused by sudden temperature changes; improved life of the fireclay due to protection of the joints between the blocks; reduction in air leakage or infiltration; accessible supporting means for the veneer blocks; long life of the veneer blocks; and easy means of replacement without disturbing the main arch.

Sprung arches may be equipped with the silicon carbide veneer construction by employing suitably tapered fireclay blocks instead of the standard brick shapes ordinarily used in spring arches. This provides proper protection to a sprung fireclay arch and adds but little to the thickness and weight of the final structure.

In addition to providing a protection for complete arches, the veneer may also be used in any part of an arch where severe local conditions exist and thereby protect these sections from a failure that would endanger the entire structure.

Device for Proportioning Chemicals to Boiler Feedwater

A SIMPLE METHOD of proportioning a chemical solution and feedwater is described by the accompanying sketches and text. The chemical solution is proportioned

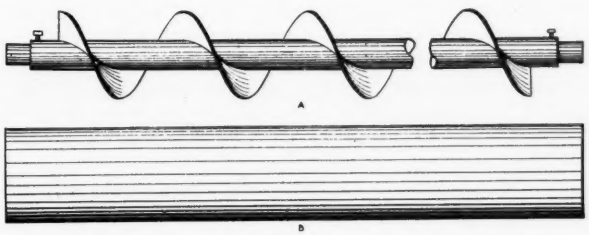


FIG. 1. PRINCIPAL ELEMENT OF CHEMICAL PROPORTIONER

by a simple apparatus which may be called a "medicine dropper," shown by Fig. 1, and works on the principle of the Archimedian screw.

Two droppers are required which are exactly alike, one being used to measure the chemical solution, the other, to measure the feedwater. Thus, the measures being duplicates, only one will be described. Procure two pieces of 8-in. helicoid conveyor, each from 2½ to 6 ft. long according to local conditions where the apparatus is to be used. These pieces of conveyor are to be the plain black variety, just as they come from the manufacturer. Have a sheet metal worker make a sleeve or cylinder of black sheet steel, to fit snugly over conveyor A, Fig. 1. Before putting the shell in place, insert a short shaft in each end of the piece of conveyor and tap in set screws to hold the shafts firmly in place. Next, remove the shafts and set screws and send the conveyor, in its shell, to be fully galvanized with no leakage between the conveyor and its shell or covering. Next, mount each dropper in a light frame to which may be attached the necessary bearings to receive the short shafts. A small miter gear is to be placed on one of the shafts,—the one which is to be uppermost when the measure is mounted in the frame. A short shaft carrying another miter gear should be attached in suitable bearings, to the top of the frame, to drive the measure through a light sprocket on the far end of the horizontal shaft.

Two tanks should be provided, as shown at A and B, Fig. 2, one tank for chemical solution, the other for raw feedwater. The lower end of a frame should be set in each tank, with the frame pivoted in such a manner that the frame can be swung down nearly to the top edge of its tank and swung upward to a point where liquid will no longer be carried up and discharged by the measure. In operation, the measure in the smaller chemical tank will stand more nearly vertical. The water measure in tank B, having to deliver a much greater volume of liquid, lies more nearly horizontal as shown. The height of liquid in tanks A and B is immaterial, as the measures will work properly as long as the lower end of each is submerged, no matter how low or how high may be the surface level in the tank. Each measure may be designed as an internal Archimedian screw. The liquid in the measure cannot run down, and the liquid discharges the instant the measure begins to revolve. The quantity of liquid discharged can be regulated by changing the angle of the conveyor

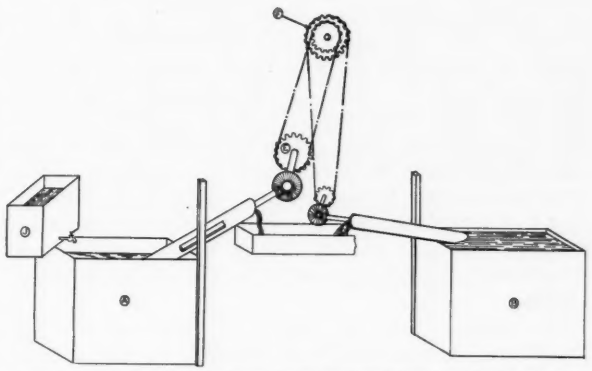


FIG. 2. DIAGRAMMATIC ARRANGEMENT OF PROPORTIONER

axis, or the speed of rotation; therefore, it will be noted that the sprocket gears on the measure counter shafts E and F, are of unequal diameter, the measure in tank A being made to revolve slower than the water measurer in tank B. Both measures are driven from the same shaft by means of slack chains.

It is not advisable to mix the chemicals in tank A, in which should be placed only a solution ready to be fed into the feedwater. To this end, let another tank J, be placed above tank A as shown. This tank may be fitted with a power driven agitator for mixing. The chemical should be mixed with a certain quantity of water and well dissolved, after which the solution may

be allowed to run into tank A, wholly or in part as required, thus permitting the liquid in tank A to be always of uniform strength.

The discharge from the two measures is to be delivered into a well or tank from which the boiler feed pump draws its supply.

Once adjusted to deliver the proper amount of chemical and of water, these measures are to be started and stopped together as found necessary to provide a proper quantity of feedwater.

Indianapolis, Ind. JAMES F. HOBART.

Strains Reduced by Applying Heat

MR. DAVIS, on page 572 of the May 15 issue, explains in an interesting way the action of heated metals. I have used the same method that he suggests in the next to the last paragraph many times but I never stopped to think why it worked. It was shown to me by an old

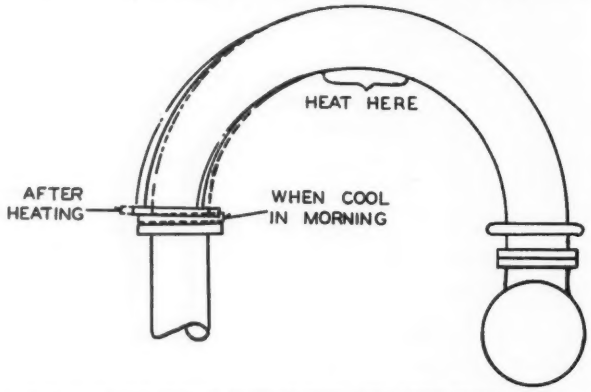


FIG. 1. PIPE BEND CORRECTED BY APPLYING HEAT

power plant construction and erection man one day when we were putting in a line to a new turbine and found out that when we came to the throttle valve that the pipe would not line up without springing. This would of course throw a strain on the turbine and was not to be tolerated, I was just a machinist's helper then and did not know what to do but the engineer of the plant insisted that it be taken back to the plant machine shop and bent the necessary amount. Of course the erector agreed to this readily enough but suggested that it be left until morning so as to let the rest of it season a little.

At quitting time, he came and asked me whether I could stay around and work overtime for him a little while. I was only too glad to do it because he was an exceedingly capable fellow who knew his business and liked to talk when there was no crowd around. After the rest of the men were gone, he warmed up the old kerosene torch (this was before the days of gas welding) and remarked that he would have a little surprise for the chief in the morning. The pipe was about as shown by the sketch Fig. 1, and he began to heat it on the inside of the bend. Of course it began to go more and more out of line and I asked what it was all about. He wouldn't tell me but told me to take careful note of where he applied the torch and notice where the pipe was in the morning. When we left, the pipe was about twice as far out as it had been before but in the morning it was right on the dot.

I have used the method several times since although

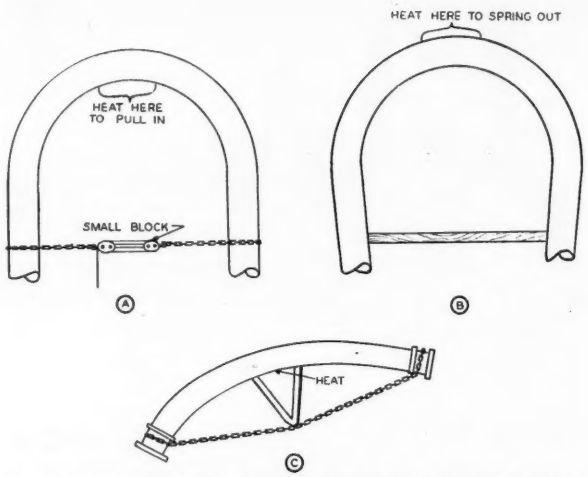


FIG. 2. PIPE HELD WHILE HEAT IS APPLIED PERKS UP THE BENDING

I have never reached the proficiency that he did, as I usually have to apply the heat two or three times. If the bend is considerable, a chain block applied across the legs as in Fig. 2A or the arrangements like Fig. 2, B and C speed up the work. In the oil and gas fields of the southwest, I have seen welders bend pipe in the field by a somewhat similar method. They use a considerable length of pipe beyond the bend so as to get leverage, then heat the pipe up for a considerable distance all around the pipe. They then slowly put a little water on the inside of the bend, easing over the end of the pipe as the contraction bends it. The end is then anchored and the entire circumference heated up again and the cooling repeated. I have been told that a good welder can bend 6-in. pipe by this method but that 4-in. is generally considered the maximum size to be attempted by the average person. They make comparatively long radius bends up to 90 deg., I understand, and although it might be possible to make the bend heating only the inside, the cold bending of the outside fibres would put quite a strain on them.

Springfield, O. F. PAUL.

Insulation for Tops of Boilers

HAVING RECENTLY had the occasion to be on top of a boiler, the writer's attention was focused on the amount of heat loss that takes place through the top surface of a boiler. Every possible means to conserve heat by air-proofing and covering the boiler settings particularly the side walls is taken, but from observation the top of the drum is generally neglected. This may not be true in recent installations, but for boiler plants that have no top insulation other than fire brick, I would recommend the following treatment:

Cover the brick with a 3-in. layer of asbestos cement and after that is thoroughly dry, apply two coats of any patent water-proof roof cement. This latter coating will eliminate the softening and crumbling of the asbestos covering due to water dripping on it.

The increased boiler efficiency will more than pay for the initial cost of the top covering, which, by the way, will last as long as the boilers.

Philadelphia, Pa. ROBERT H. BEAL.

Factors Involved in Selecting Industrial Fuels

WITHIN the last few years, the selection of a proper fuel for a particular purpose has been given a great deal of attention, as is shown by the amount of high cost fuel equipment being installed. The most suitable fuel and furnace for any given operation is a problem that is difficult to solve and only after a thorough analysis of the conditions involved should the selection be made.

For processes, cost of fuel at the furnace door should not always be a determining factor in its selection. The mere fact that the amount of spoilage might be reduced, labor eliminated, as far as fuel handling goes, that furnace atmospheres and temperatures require close control and that as a result a more uniform and perfect product can be turned out with the high initial cost fuels, should not be disregarded or thought to be too expensive without careful investigation.

The principles of combustion are common to all fuels but the results obtained are different. Individual processes render a choice extremely difficult, as one operation will require high temperatures, another a reducing atmosphere, a third close control.

Gas, having a wide range of adaptability, seems to fit in where other fuels can not be used. Owing to the unfortunate fact that natural gas production is, commercially speaking, of such a limited area, the principal consideration is often confined to manufactured gas. Industrial gas has advanced far enough to merit full acknowledgment and the perfection that may be obtained with gas regulating devices is remarkable and has more to do with the popularizing of gas for fuel than any other single improvement. An erroneous idea that seems to prevail among some of the new gas users is that gas may be consumed in a proper or at least a fairly economical manner without a flue or chimney. This is contrary to facts, as the full available heat content and safety from dangerous fumes cannot be obtained without chimney capacity and proper control dampers.

Cost of gas and electricity, and their lack of waste products force the conclusion that a special furnace is the only practical means to realize the good features of these more expensive fuels. The many offsets to this additional cost often prove that highest price fuel is the most economical. The ultimate decision should rest first on a consideration of the cost per unit of goods and second on the various secondary advantages of convenience and cleanliness, which are important items.

As an example; in low-pressure operation, such as low-pressure steam boilers, coal operation at 40 to 50 per cent efficiency is not uncommon, while gas-fired boilers are considered of poor design if they do not utilize more than 80 per cent of the gross heat of the gas. With oil and the usual methods of firing, its efficiency runs about midway between gas and coal, but in this connection the amount of gas or oil required and the price charged may greatly restrict its use; a feature to be considered is that the efficiency of combustible fuels drops off rapidly for high-temperature operations, while the efficiency of electric furnaces remains fairly high. Investigation of high-temperature work along the line of electric furnaces will definitely prove that this costly method of heating is more economical and useful when the heat may be well conserved, that is the doors of furnaces opened only at long intervals. The efficiency obtained with electric furnaces and the better product will usually offset the difference in cost of electricity against other fuels.

Power plant engineers are often consulted or have to do with furnaces for process work. If the engineer so concerned will investigate what furnace precision has done for the automobile industry, where the cost of raw materials going into a car today is twice the cost of what they were before the war and the car sells at one-half the price, he will find much valuable data on high cost fuels, that have made mass production and mechanical handling possible.

Brooklyn, N. Y. WILLIAM ANDERSON.

Sand Blast on Boiler Tubes Not Advisable

REFERRING TO the interesting article by R. S. Leach under the heading, "Sand Blast Found Effective in Removing Soot," appearing on page 816 of the August 1 number of Power Plant Engineering, I have no doubt that the method is effective and it may be all right under certain conditions where the soot under extremely difficult conditions cannot be removed any other way. But for regular day after day soot removal, I am inclined to believe that in the end it would be an expensive cleaning method, owing to the wear and tear on the boiler tubes.

For instance, it has been demonstrated that when steam jets of soot cleaners are so placed that the jets blow directly against the tubes, rapid erosion takes place. In support of this fact, read the section on Steam Boilers by the late Arthur D. Pratt in Marks' Mechanical Engineering Handbook. Mr. Pratt wrote:

"If the steam jets are so placed that they impinge directly against the tubes, erosion may take place."

That was written many years ago and since then steam pressures have been stepped up considerably so that steam velocities are much higher today than they were then, consequently the danger is greater; and with that method, we have only the slight grit in soot and

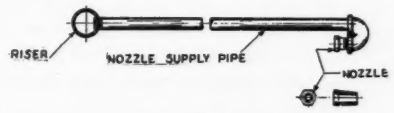


FIG. 1

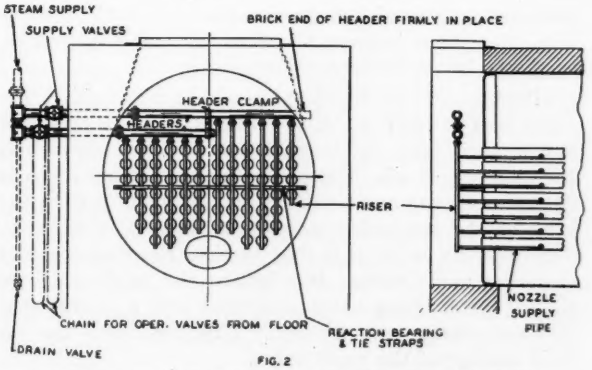


FIG. 2

FIG. 1. DETAILS OF NOZZLE AND SUPPLY PIPE
FIG. 2. ARRANGEMENT OF NOZZLES FOR REMOVING SOOT FROM HORIZONTAL RETURN TUBULAR BOILERS

ashes to do the cutting. Sand, surely, is much worse.

A method that I consider better than Mr. Leach's method is illustrated in Fig. 1 herewith. It is a "vacuum cleaner" method. Instead of blowing against the natural draft as is usually the case this device blows with the natural draft.

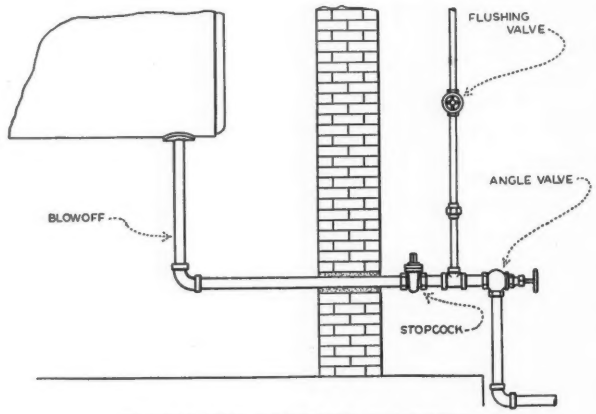
Figure 2 at the right shows how these cleaner pipes are inserted in the tubes and how all of them are connected to a common header or riser. At the left of Fig. 2 you can see how the boiler is divided into two sections so that one-half of the boiler is cleaned by opening one of the supply valves shown at the extreme left. After that valve is closed, the other valve is opened and the remaining half of the boiler is cleaned.

There is another use for this design; for instance, when there is a sudden demand for steam one of the valves can be cracked, thereby intensifying the draft and boosting the fire quickly.

Newark, N. J. W. F. SCHAPHORST.

Flushing the Boiler Blowoff

IN A POWER plant containing three horizontal return-tubular boilers, the operating man has installed a flushing line for keeping the blowoff apparatus in good working order. The blowoff pipe from each boiler is fitted



PIPING FOR BLOWOFF FLUSHING

with a stopcock and an angle valve, the blowdown current being released and checked by means of the stopcock. The globe valve is used to intercept leakage in case the stopcock plays out. The flushing line branches from the main feed line and is connected to the blowoff pipe at a point between the stopcock and angle valve, as shown in the accompanying sketch.

Purpose of the flushing line is to wash the angle valve free of mud, scale, or sediment that may remain lodged in it after the boiler has been blown down and the stopcock closed. The procedure in blowing down is first to open the angle valve wide and then to turn the plug of the stopcock gradually until it is wide open. The reverse operation is first to close the stopcock and then the angle valve. But before the angle valve is closed, the flushing valve is opened and a liberal shot of clean water sent through. This treatment insures tight seating of the angle valve.

When this valve needs either regrinding or a new disc, the job can be done in comfort by cracking the flushing valve and letting a little cold water flow in to cool the pipe.

Another advantage is that, if scale or sediment collecting in the vertical section of the blowoff pipe connected directly to the boiler cannot be forced out under boiler pressure, the stopcock can be opened and a current of water sent in from the flushing pipe, under whatever pressure may be necessary to force the obstruction back into the boiler, whence it may flow out freely at the next regular blowing down.

St. Louis, Mo. D. J. ALTIZER.

Condenser Coil Offered Difficulty in Cleaning

DIFFICULTY was recently experienced with a small automatic refrigerating unit installed to cool the ice cream containers in a drug store, in not keeping up to former capacity. The first indication of trouble was apparent loss of ammonia and when charged it would work satisfactorily for a few days only and then seemed to require more ammonia. It was first thought that the compressor was at fault and it was taken apart and though the water jacket was badly in need of cleaning, the mechanical part of the compressor was in good condition and when again placed in service showed but little improvement. The condenser was the next part to receive attention and the coil was found to be almost completely plugged. The condenser was made of a spiral coil of ¾-in. pipe coiled close when removed, and presented a problem to clean.

It was first thought that it could be cleaned by tapping the outside of the coil with a hammer but this was not successful and a snake wire was tried but without any better results. After trying various other methods the coil was placed in the firing side of a garbage incinerator, couplings being screwed on the threaded ends to protect the threads, and allowed to get heated to a dull red and remain that way for about half an hour then removed and cooled off. We tried to blow out the ash with air but it was too tightly packed. It was noticed, however, that when the air hose was removed there was considerable dirt came out of the coil and by repeatedly applying air pressure and quickly releasing it the dirt was removed and the coil replaced in the machine which is now giving excellent results.

Boston, Mass. M. W. EASTMAN.

Elimination of Free Ammonia in a Brine Tank

AMMONIA in brine is not harmful if the percentage is small but when it accumulates in large quantities it should be neutralized. Have a chemist analyze the brine to determine the amount of free ammonia. Knowing this, and the amount of brine contained in the tank, the chemist can easily ascertain the quantity of acid necessary to neutralize the ammonia.

With the agitator running at high speed, add the acid in small quantities so that an even and quick distribution will take place. If any free ammonia is present after 30 to 40 hr. of continuous agitation, more acid should be added, and this kept up until the brine reaches its slightly alkaline nature.

Philadelphia, Pa. ROBERT H. BEAL.

Questions and Answers

Collector Ring Trouble

I WAS MUCH interested in the question asked by C. G. H. in regard to his collector ring trouble in the August 15 issue. My suggestion is that C. G. H. turn or grind this ring in place while the engine is running. Evidently at some previous time the ring was removed and in replacing, a burr on the crankshaft caused by the setscrew which holds the ring in place was not filed down; as a consequence of the ring riding this burr, it has become eccentric with the shaft.

Of course the ring can be removed and placed in a lathe and trued up in that manner but the preferable way, even though it may take more time, would be to round it up on the shaft. It is impossible to true a condition such as this up with a stone—the black spot may be brightened to a certain extent, but the "hollow" will still remain. The pitting, as a rule, will extend quite a distance beneath the surface and although small, these pits must be removed until the real smooth surface shows up. After the engine is stopped, I would place a piece of fibre or cardboard between the brushes and the ring. This is a simple matter requiring only a moment and it will keep the rings in good condition.

New Orleans, La. J. B. PROCTOR.

REFERRING TO THE question by C. G. H. as to the cause of his collector ring trouble, we had exactly the same thing happen on a 50-hp. set. It finally turned out to be a loose key in the flywheel which caused a slight jar at the burned spot on the ring.

We heated the hub bolts and let them draw down the hub tightly on the shaft. Since then the spots never came back. The bolts should not be heated too much and the nuts tightened by hand moderately to avoid putting too much strain on the bolts.

Pine Bluffs, Wyo. E. H. HARVEY.

Bursting Pressures of Cylinders

How DO YOU figure the bursting pressure of a cylindrical vessel subjected to internal pressure?

2. How do you figure this pressure in a cylindrical water leg, such as in a Manning boiler, with staybolts and without staybolts? 3. What is the effect of the staybolts? W. H.

A. 1. In a plain cylindrical vessel, such as shown in Fig. 1, the bursting force exerted normal to any diameter would be $P \times D \times L$ and the resistance with which the metal offers to this tearing apart would be $TS \times 2t \times L$ so that at the point of bursting

$$P \times D \times L = TS \times 2t \times L$$

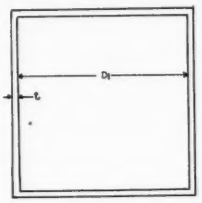
Where

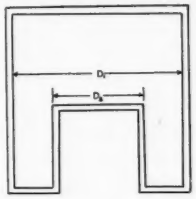
TS = the tensile strength of the metal in lb. per sq. in.
L = the length of the section in in.
t = the thickness of the plate in in.
P = the internal pressure in pounds gage.
D = internal diameter in in.
R = internal radius in in. = D ÷ 2.

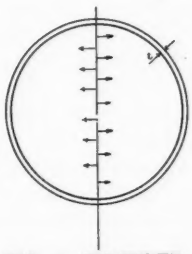
Canceling out L which appears on both sides of the equation and transposing would give the maximum pressure as follows:

$$P = \frac{TS \times 2t}{D} = \frac{TS \times t}{R}$$

2. In the water leg, Fig. 2, without staybolts it is obvious that the bursting pressure on the outer shell would be the same as before. The pressure on the internal surface would act inward, however, with a force







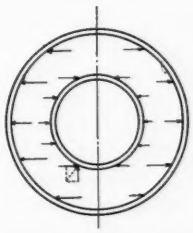


FIG. 1. CYLINDER FIG. 2. WATER LEG

equal to $T \times D_2$ where D_2 is the larger diameter of the inside shell of the water leg. If staybolts were installed to carry this force from the inside to the outside surface, it is evident that the pressure acting inward on the inside of the leg would balance some of the pressure acting outward on the outside shell, giving a net outward pressure of $(P \times D_1) - (P \times D_2) = P(D_1 - D_2)$. Equating this to the strength of the metal, we would get $P(D_1 - D_2) = TS \times 2t$ or changing and transposing

$$T = \frac{TS \times 2t}{D_1 - D_2} = \frac{TS \times t}{R_1 - R_2}$$

where R_1 and R_2 are the radii corresponding to the diameters D_1 and D_2.

The above theoretical answer considers no factor of safety and is made without considering the structural requirements of the A.S.M.E. Boiler Construction Code. For an actual boiler the allowable pressure on the water leg would be figured as explained on page 819, Aug. 1, 1931, issue.

3. Properly installed staybolts increase the maximum allowable pressure on the water leg.

Editorial Comment

Power for Cost Reduction

In a paper before the World Social Economic Congress at Amsterdam, E. A. Filene discussed mass production and mass distribution with their effects on standard of living and stability of governments. His argument was that mass production, to deliver large output, unless accompanied by provision to make that output available to the mass of the people is of no avail in improving business or living standards and, unless most of the people have satisfactory conditions such as steady employment, satisfactory wages and high standard of living, social unrest and effort to change governmental organization will be sure to result.

History seems to justify his argument and the problem then becomes how best to secure mass distribution for the mass production which has been largely achieved.

In order that products may be most widely distributed, evidently three things are necessary: Desire of a great many people to have those products; price which will appeal to great numbers of people as reasonable; ability of large numbers of people to buy what they desire and feel is worth the price asked.

What factors enter into these questions of desire, price and buying ability and what part can the wide use of power play in achieving mass distribution?

Factors in price include materials, labor, overhead, handling and shipping, selling and profit. Of these, buying the most suitable materials at the right price is a matter of good judgment and of the other fellow's success in solving his problems of mass production and distribution. Cost of labor and overhead are closely related and bound up with the other problem of maintaining high mass buying power. Overhead on plant and machinery goes on regardless of hours worked, so that reducing hours will increase overhead cost per unit of product. In some lines, using two or more shifts may serve to advantage but, if this overburdens the market with product, it aggravates the difficulty of distribution. The claim of some that, "there is no such thing as overproduction if price can be made low enough," does not stand up well under analysis.

Use of power to increase productive ability has proved one of the greatest factors in achieving mass production and lowering costs. For machine drive, feeding, handling and conveying it is cheaper and more effective than muscle power and its use wherever possible will usually prove good economy, being careful always that it is used efficiently.

As to wage rate, Mr. Filene argues that it should be as high as possible without increasing the cost of the product. So long as added wage incentive results in increased output so as to reduce or at least not to increase cost per unit of product, it is beneficial, because it adds to general buying power. This seems a question to be settled by trial in each case, the chief difficulty being in sorting out from among other causes just what effect increase in wage rate has on production cost. Coöperation of management and workers is needed, which often requires great diplomacy, especially if it should appear that the wage rate has gone too high and should be reduced to lower the cost of unit product so as to widen the market.

In handling, trucking, transporting, lifting, evidently power should be used to the maximum possible. Human or muscular exertion can never compete in economy with mechanical or electrical power for such work.

Selling, the creation of desire for a product and proving that the price is reasonable and that the economy or gratification to be gained from ownership is worth the price lends itself less readily to analysis. But the power of advertising to create desire and demand for products has been so often proved as to need no advocacy here. The most important point is to plan so as to reach with greatest effectiveness those buyers who can use a product to advantage.

All past experience goes to show that, in solving the problems of reducing production and distribution costs, most generous use of power and light, efficiently utilized, has always aided in increasing output, increasing return to workers, lowering cost of product and thereby aiding mass production, mass distribution and mass buying.

Engineers for Power Equipment

It would seem obvious that, when an installation for power generation or use is being planned, the services of engineers familiar with and experienced in such work should be employed. That careful study should be made, in the case of large plants or buildings as to the relative economy of generating or purchasing power also seems obvious, especially now that improvement in equipment and operating methods for individual plants has progressed so that their performance is comparable to that of central stations.

Yet C. M. Garland of Chicago in an open letter to architectural and engineering societies voices a strong protest against the practice of some architects, when designing buildings, of assuming that current should be purchased. For buildings of the size now often erected, he states that experience of most architects or of heating and ventilating engineers is inadequate to fit them to decide on this point. His statement that in almost every loop block in Chicago, a loss of $150,000 to $300,000 a year is incurred because purchase of current has been accepted as the economic course and heating has been planned by men inexperienced in such large installation is worthy of careful consideration. He also states that in many investigations, his company finds that the building owner could save the cost of power generating equipment in two to five years. He states that investigation of plans for the new Chicago Postoffice building indicates a yearly loss of $80,000 by purchasing current, yet that the architect's office at Washington advises that it is uneconomical to generate power.

While Power Plant Engineering holds no brief for generation of power in individual plants when purchased

current will be more economical, conditions such as cited by Mr. Garland would indicate that greater care is needed in determining which is the better plan. To jump to a conclusion without investigation is certainly neither good engineering nor good sense and it should be possible to convince those responsible for furnishing the money that such investigation ought to be made by engineers competent to decide.

The point of attack to ensure proper consideration of the problem would seem to be the bankers or building owners whose pocket books will be directly affected by the loss involved in a wrong decision. Are power engineers neglecting a situation that calls for an active campaign to emphasize the service they can render?

Off Duty

Among the countless thousands of more or less superfluous pieces of printed matter published by the government printing office at Washington, D. C., there is one that is worthy of note, if not for its content, at least for its voluminous proportions. This is what is known as the "Official Gazette," a weekly publication issued regularly since 1872 and containing claims and descriptions of all the patents issued by the patent office. Every week it makes its appearance with several hundreds of pages between its covers.

No person who examines a copy of this publication for the first time can fail to be impressed by the amazing mass and variety of its content. Indeed, no volume published so expresses the character of the age we live in as does this book—an "Age of Gadgets," so to speak. Here we find the sane and insane ideas and brainchildren of countless inventors; good, bad and indifferent, useful and useless, portrayed graphically and expressed in cumbersome, cabalistic legal phraseology. In its pages one will find everything from a new type of corkscrew to an improved scheme for propelling battleships. From machines for edging lingerie, to automatic violins and improved hair pins and from new ideas in coffee pots to contraptions for converting garbage into chair seats, every conceivable kind of device for every conceivable purpose will be found. For almost 60 years, every week, this volume has appeared and in all that time never once have its editors (heaven help them) appeared to run short of copy. Every new fangled device, from watermelon sorters to ionization spectrometers at one time or another have received attention on its pages. The array of devices is truly astounding and, considering them, one cannot but think of this as *an age of gadgets.* Indeed, the publication might well have been named the Official Gadgeteer and its name have been more expressive.

These gadgets—to what avail are they? We do not attempt to be able to answer this nor do we wish to pass judgment lightly, but sometimes we wonder whether these gadgets, these products of our industrial era have benefited man as much as we like to think they have. We are half inclined to agree with Dr. C. E. Mees, director of research of the Eastman Kodak Co., in his contention, expressed recently, that save in checking disease, science and engineering have been of little benefit to man. Dr. Mees doubts whether the life of the agriculturist in any country today is happier than that of a peasant in the Nile Valley 4000 yr. ago. He questions whether the inhabitants of an American city are any happier than those of a Greek or Babylonian city of the past.

After all, the mere possession of an electric toaster or an automobile or the use of a telephone does not add to a man's happiness in life. Our typewriters and high-speed printing presses, our automatic pencils and self-filling fountain pens do not write better books than those written by our forefathers with quill pens.

Happiness is not a thing which depends upon the possession of material things beyond a certain minimum. Thoreau, that comic Yankee philosopher of an earlier day, said he once found a pretty stone which he thought he would like to keep. But it gathered dust and required care, so finally he threw it away. Possession often become great cares.

Machinery, of course, has lightened the burdens of man but it also has added to his worries. In a few countries, especially in the United States, machinery has diminished the heavy labor of the farmer and added many comforts to his domestic life. But while it has done this, now it is undermining his security and in the end may eliminate him.

A few days ago, while returning from the Pacific Northwest, I found the people in the Province of Saskatchewan deploring the poor conditions of the wheat crop due to lack of rain. "And yet," I asked, "suppose you did have a good crop; what would you do with it? You couldn't sell it." And they scratched their heads puzzledly, and admitted that was true. There is entirely too much wheat in the world now.

Before the advent of machinery the farmer had his lean years, but there were always good years to compensate for them. When he had a good crop, he could sell it because in those days there was little surplus.

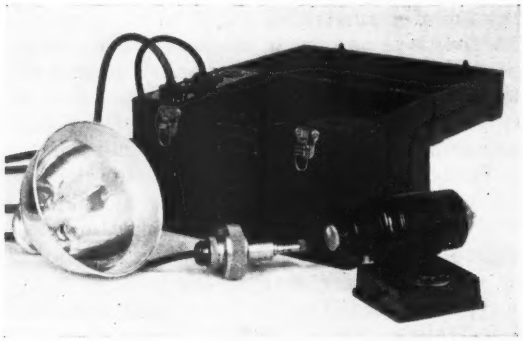
Today, machinery has changed the entire picture and the farmer with a bumper crop on his land finds himself at a loss to know what to do with it. And so, throughout the world, economists and statesmen are considering the future of the farmer with troubled faces, remembering that farming is the normal life of man and that any other life for the mass of mankind involves the greatest readjustment in our whole economic and social system.

On the whole, there is much truth in Dr. Mees' remarks and we, too, wonder whether science and engineering have contributed as much to man's happiness as we usually take for granted. Happiness is a manifestation of one's attitude towards life; it depends upon the spirit, provided that the spirit is not oppressed by a material situation of the body. A person can be happy in arduous toil or in nerve-racking sport; he can be happy in intellectual relaxation, or he can be happy in mere contemplation, but certainly he does not require a collection of "gadgets" to make him happy. An automobile, admittedly, is a convenience but not an essential to happiness. After all, it is better to walk a short distance than to ride a long one. And it is better to talk to one's friends and attend to one's business in a leisurely manner than it is to travel at breakneck speed in search of nowhere and then to dash off to office or factory, returning tired and worn in the evening. This sort of thing is not conducive to progress in culture. A little less attention to "gadgets" and little more to the cultural opportunities of our leisure hours would benefit all of us.

Power Plant Engineering Developments and News

Portable Vibroscope

TO FILL THE DEMAND for a Vibroscope of greater illuminating power than the original Model-1, which has been on the market for about 6 yr., the Electrocon Corp., 6 Varick St., New York, N. Y., developed the Model-3 vibroscope shown in the illustration.



MODEL-3 VIBROSCOPE OF THE ELECTROCON CORP.

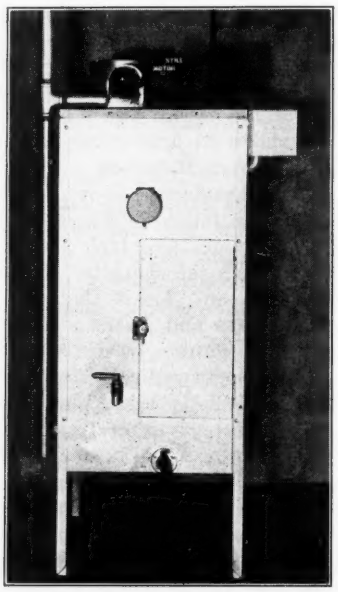
Illumination has been increased about five times and the motor unit is a new feature which has not been supplied with former models.

Instruments weigh but 24 lb., complete with batteries, and are applicable to the study of rotary, reciprocating or any kind of cyclic motion at any speed. The moving parts can be made to appear stationary or, by a phase adjusting knob on the breaker head which throws the motor unit slightly out of synchronism with the moving parts, the movements can be observed at greatly reduced speed, as in a slow motion picture.

Oil Reclaimer for Small Plants

BY THE marketing of a reclaimer with a capacity of 8 to 8½ gal. of drainage oil daily, operators of medium sized fleets, and small plants may enjoy the same proportionate savings in oil cost and engine maintenance as is being had by operators of larger equipment. Simplicity of operation and automatic features incorporated in the Midget model, reduce labor to one-half hour per batch load from start to finish, with no chemicals or other foreign substances included in the process of reclamation.

Operation is as follows: 8 to 8½ gal. of oil is poured into the machine after settling. Heater and fan switches are turned on, and the machine then run about 6 to 8 hr. to remove the liquid impurities, at which time the machine automatically shuts off. Oil starts to cool slowly and, within the hour, a valve is opened manually, which will permit the oil to flow through a series of filter pads. The oil will start flowing into the filter pads only after it cools to the proper temperature for best filtration, when a second valve opens automatically. Reclaimed



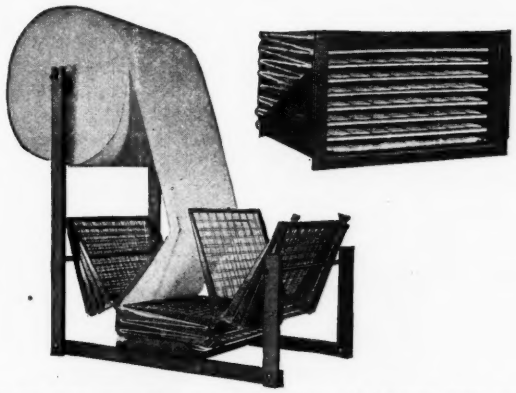
MIDGET MODEL OIL RECLAIMER

oil passes through a series of three filters and is collected in a storage space at the bottom of the machine, whence it may be drawn off for re-use. The equipment is manufactured by Skinner Motors, Inc., Detroit, Mich.

New Large Capacity Air Filter

COMPACT is a new type of dry air filter announced by the Independent Air Filter Co., 29 So. Clinton St., Chicago, Ill., consisting of a series of superimposed hinged wings, or panels, into which a continuous sheet of fabric or fibrous filter medium is folded and encompassing an unusual amount of filter surface in a small frontal area.

Merits of the original screened types were not forgotten, however, and successful attempts were eventually made to eliminate some of the early weaknesses. The development of wood pulp cellulose made possible a compromise between the original cloth strainers and the impingement type, but at first necessitated higher velocities than were consistent with proper cleaning efficiency.



ONE OF THE UNITS AND METHOD OF LOADING THE COMPACT FILTER OF THE INDEPENDENT AIR FILTER CO.

Other developments with wool fabric filters achieved high efficiency and eliminated the space objection, but failed to provide for cheap and easy renewal.

The new "Compact" air filter successfully incorporates the principle of low velocity air flow without sacrifice of space or cleaning efficiency. It is equally well adapted to either fabric or fibrous materials and has made possible the use of a new and cheap cotton fabric filter medium that possesses all the advantages of wool felt, yet can be easily and cheaply replaced. "Air Filtration by the Yard" is a slogan or descriptive phrase used by the company and refers to the method by which the new filter fabric is fed from large rolls into the filter units when the useful life of the filter medium is at an end.

Viking High-Pressure Pump

DESIGNED for operation of hydraulic lifts and elevators, also for actuating drillers, tappers and other machine tools, these pumps are manufactured by Viking Pump Co., Cedar Falls, Iowa, in capacities of 5 to 45 g.p.m. at 1200 r.p.m. and for pressures up to 500 lb. per sq. in.

Figure 1 shows the principle of action, the rotor and idler meshing between ports to form a barrier, then opening up to receive liquid and carry it on as the idler draws away from the inlet port. Liquid is carried around between rotor, idler and baffle plate and as the idler and rotor again come into mesh, is forced out of the delivery port. It will be seen that the pump will operate when rotating in either direction.

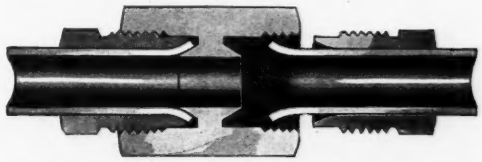
Figure 2 is a longitudinal section through casing, rotor, idler and baffle. In actual construction, ports are located on opposite sides of the casing, the rotor is carried on tapered roller bearings and the idler is mounted eccentric on a bearing carried in the outer head. Mounting of the pump is by means of a hub and flange, for direct coupling or for belt or pulley drive.

For the 5-g.p.m. size, ports are ½ in. diam. and power required 3 hp.; for the 45-g.p.m., ports are 2 in. and power is 20 hp. Best efficiency is at 175 to 275 lb. according to size of pump but, in the larger sizes particularly, efficiency is well maintained up to 500 lb. pressure.

Dieform Compression Fittings

TO MEET the need for leak-proof and trouble-free small service lines in the power plant and industrial field the Bailey Meter Co., Cleveland, Ohio, has announced Dieform compression fittings and tubing.

The exploded view of a Dieform tubing union illustrates the method in which the joint is made. The left-hand side of the tubing union is shown with the tube



SECTION THROUGH DIEFORM UNION

in place and the tube nut screwed down tightly to complete the metal-to-metal joint, while the right-hand side shows the tube nut unscrewed and slipped back along the tubing, which in turn is removed a slight distance from the seat in the fitting. This illustration shows how the tubing is securely gripped between the seat in the center fitting and the seat on the tube nut, resulting in a perfectly tight, dry, permanent joint.

In flaring the tubing, the Dieform Nut serves as a die, to assure a perfect seat with the angle properly proportioned to the size of the tube. The moderate angle of flare prevents the tube from splitting or cracking and also permits the use of hard drawn tube when desirable.

Double extra heavy brass fittings with extra heavy soft annealed or half-hard copper tubing are suitable for pressures which do not exceed 800 lb. per sq. in.

FIG. 1. PRINCIPLE OF ACTION OF VIKING ROTARY PUMP

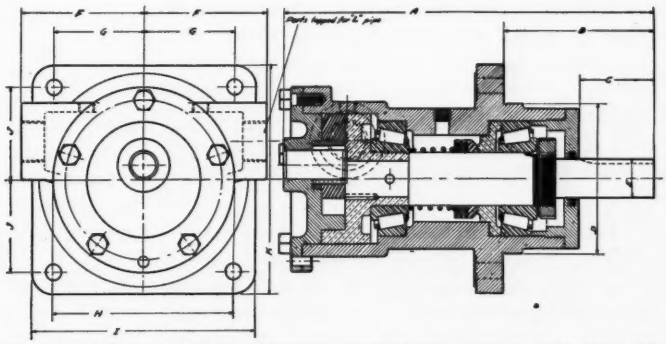
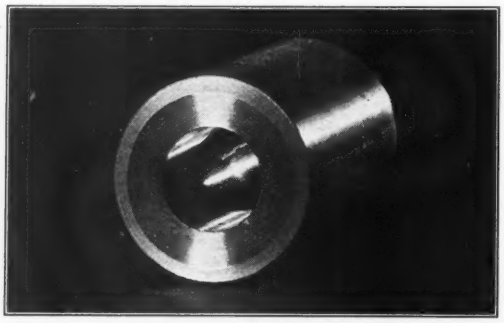


FIG. 2. LONGITUDINAL SECTION THROUGH CASING, ROTOR AND IDLER

and where the intermittent temperatures are under 600 deg. F. Where higher intermittent temperatures are expected, steel or Monel compression fittings are recommended. Steel tubing should be used for pressures in excess of 800 lb. if the installation is subject to steam temperatures at intervals, although for hydraulic lines extra heavy copper tubing is satisfactory for pressures up to 2000 lb. per sq. in.

Seamless Steel Tube Lined with Alloy

LINING STEEL TUBING with a variety of metals or alloys by means of a new method has just been announced by the Detroit Seamless Steel Tubes Co., Detroit, Mich. In combining the inner lining metal with the outer steel shell, the two metals are bonded by fusion so inseparably there is no evidence of separation. In fact, the tube turnings will curl off the tool so integrally united that the spiral form shows both textures of the



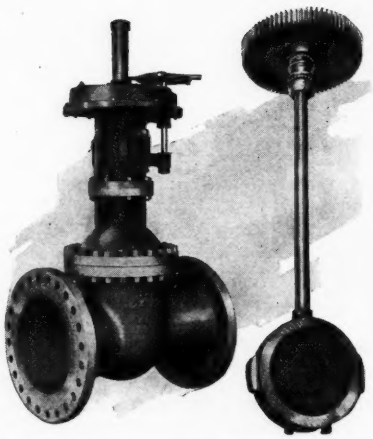
SEAMLESS STEEL TUBE OF THE DETROIT SEAMLESS STEEL TUBES CO., LINED WITH COPPER ALLOY BY THE BROWN PROCESS

bonded metals as one continuous strip without fracture at any point between the two. One of the important fields of steel tubing is the production of steel-backed bearings. The combining metal is cast into the tubing by a centrifugal process to insure uniform distribution of the lining material on the periphery of the tube so that only the minimum of machine work is necessary.

A wide variety of metals and compositions can be utilized in the lining process, rendering this method adaptable to many commercial uses aside from bearings. Among the lining materials already successfully used are bronze, copper and tin alloys and other nonferrous metal. Practically every kind of bearing bronze can be used. Other practical uses include tubes lined with noncorrosive metals for conveying liquids whose chemical properties deteriorate steel, tubes used in boilers where a lining metal of high heat conductivity is advantageous, and water pipes to displace copper piping and other materials where strength is a desirable factor.

Ball Thrust Bearing Gate Valve

GATE VALVES like the one shown are now being installed in the 1000-mi. gas line which when completed will bring natural gas from the Texas oil fields into Chicago. The diameter of the pipe is 24 in.; the working pressure will be 600 lb.



VALVE AND STEM, SHOWING THRUST BEARINGS AND RENEWABLE SEATS

The valve shown is manufactured by National Machine Works, Chicago, Ill., especially for this class of service. The valve is of cast steel, measures 48½ in. from face to face, has an inside diameter of 16 in. and weighs 5000 lb. It has a total lift of 17 in. Two Aetna ball thrust bearings are used to make it possible to open and close the valve with little effort, it is claimed, even with 1000 lb. pressure on one side only. The discs of the gate are of high carbon steel and accurately ground; faces of the seats are nitro-alloy, also accurately ground, to assure a perfectly gas-tight contact and freedom from corrosion.

Improvements on Commutor Grinders

IMPROVEMENTS in its commutator and slip-ring precision grinders are announced by Ideal Commutator Dresser Co., Sycamore, Ill.,

In the Perfect model grinder, Fig. 1, one change was made in the screw, which is now located in the back of the bed plate, rather than in the center, to reduce chances of binding caused by the grindings being thrown upon it. The head now rides on a solid plate, rather than rails, to make possible more precise adjustment. The stone tools are now held by one plate to assure a

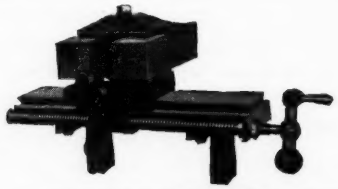


FIG. 1. NEW PERFECT MODEL GRINDER

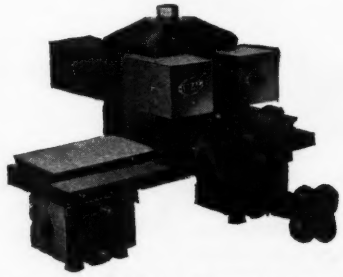


FIG. 2. NEW IDEAL MODEL GRINDER

more rigid hold than the two clamps. The cross feed handle of the lathe style has been found more satisfactory to operate than the wheel type.

On the Ideal model grinder, Fig. 2, the rack gear has been reversed for the same reason as above. In place of the wheel or lathe type handle, a star knob handle, is now supplied.

General Service Pump

NEW CAMERON general service centrifugal pump, designated as the Class RV, is announced by Ingersoll-Rand Co. of New York City. Both the pump and the electric motor that drives it are assembled together to produce a compact, light-weight, easily handled unit. This construction is to promote dependability and to reduce the needs for attention by minimizing the number of revolving parts and bearings and eliminating the use of a coupling.

Class RV is designed for any pumping service requiring a small or medium capacity unit for operation

CAMERON CLASS RV GENERAL SERVICE PUMP

against moderate heads. It is suitable for such applications as circulating and cooling systems, standpipe and water supply systems in factories, warehouses and apartment buildings and general transfer and handling service of any reasonably clear liquid.

This pump is made in six sizes and can be furnished mounted on a structural steel bedplate to facilitate installation, if desired.

Calculating Board for Commonwealth Edison Co.

AN ORDER FOR the first alternating current calculating board ever received for commercial use has been obtained by the Westinghouse Electric and Manufacturing Co. The order came from the Commonwealth Edison Co.

The purchase price is approximately $50,000. This calculating board for the Commonwealth Edison Co. will be located at the company's headquarters in the Edison Building at Chicago and will be used to determine system operating conditions under various loads and schemes of operating. It will enable engineers to design the interconnected system for the maximum reliability and economy in investment and operation. It will furnish engineers with valuable information regarding operating conditions.

Only two other alternating current calculating boards are in use. One is in the Westinghouse Electric Works at East Pittsburgh and the other is at the Massachusetts Institute of Technology at Cambridge, Mass.

News Notes

ANNOUNCEMENT WAS made recently by the Worthington Pump & Machinery Corp. that it had acquired the manufacturing and marketing facilities of Metalweld, Inc., Philadelphia, Pa., builders of a complete line of portable compressor units. Last year the Worthington Corp. took over the manufacture and sale of Gilman rock drills and accessories, and these new added products will enable the corporation to supply all the equipment required for contractors, railroads, utilities and industrial users.

THE RELIANCE GAUGE COLUMN Co., Cleveland, Ohio, has announced that it has purchased the safety water column, water gage, gage cock and gage glass illuminator business of the Roberts Steam Specialty Co. and The Cleveland Flue Cleaner Mfg. Co., both of Cleveland. Some of these products possess considerable merit, but all are being put through the Reliance engineering department for further improvements and consolidation with the Reliance line.

TIMKEN ROLLER BEARING Co., Canton, Ohio, reports the receipt of an order for the bearings for 150 of the new electric locomotives to be built for electrification of the Pennsylvania Railroad between New York and Washington. The order includes tapered roller bearings for all of the engine trucks and the driver wheels of 90 passenger locomotives, designed for speed of 90 mi. per hour and 60 for freight service.

Heretofore electric locomotives have been equipped with plain bearings. The equipping of these locomotives with Timken bearings is the result of long experiment and the development of a particular type of bearing and mounting especially suited to this work. About two years ago, the Timken Co. had built a high grade steam locomotive equipped throughout with its bearings. This locomotive has been tested for a year and a half on 11 of the great eastern railroads, and is now being tested by the great western railroads. It has already gone over 75,000 mi. and been handled by over 500 different train crews.

JOHN S. BLEECKER has been appointed manager of sales of Lukenweld, Inc. (Division of Lukens Steel Co.), Coatesville, Pa. He was graduated from the Massachusetts Institute of Technology in 1898 in mechanical and electrical engineering, from 1901 to 1928 held executive positions with Stone and Webster, Day and Zimmermann and Bates, Inc., and from 1928 until his association with Lukenweld, Inc., in 1831, engaged in industrial and public utility engineering work.

PEABODY ENGINEERING CORP. announces that the H. W. Kaiser Co., located at 1836 Euclid Ave., Cleveland, Ohio, is now acting as representative for that company in the northern Ohio section. Mr. Kaiser was formerly connected with the Hughes Limbach Co. which formerly represented the Peabody Engineering Corp. in this district.

ANNOUNCEMENT has just been made by the Illinois Stoker Co. of Alton, Ill., that the Sullivan Valve & Engineering Co. of Butte, Mont., and Leonard H. Pratt of Detroit, Mich., will represent the company in their respective districts.

MACEY S. GOOD, who has served for the past 10 yr. as manager of the Chicago sales office of the C. A. Dunham Co., has recently been appointed as Division Manager with headquarters in the Dunham Bldg., Chicago.

AMERICAN Smoke & Soot Washer Co., Inc., announces the removal of its offices from 55 W. 42nd St. to 1775 Broadway, New York City.

THE FULLER LEHIGH Company, 85 Liberty St., New York, N. Y. announces the removal, on August 28, of its Boston Office from 80 Federal St. to 49 Federal St. H. H. Leathers continues in charge as District Sales Manager.

Books and Catalogs

CENTRIFUGAL PUMPS, a booklet published by the United Iron Works, 580 Second St., Oakland, California, covers the elementary theory, characteristics and construction of centrifugal pumps with particular attention given to the pumping of oil and other viscous liquids. This booklet was prepared by Michael D. Eisenstein, Chief Engineer of the company, from copy written for the Pacific Coast Gas Association Handbook.

PRINCIPLES OF ELECTRICITY. By Leigh Page and Norman Ilsley Adams, Jr.; cloth, 620 pages, illustrated, size 6 by 9 in. D. Van Nostrand Co., Inc., New York, 1931; price, $4.25.

This seems to be an excellent book for those having a substantial knowledge of mathematics and physics; it requires a knowledge of elementary calculus. According to the authors' preface, the purpose of the book is to provide an elementary text suitable both for undergraduates who have completed general courses in physics and in the calculus such as are usually

given in the sophomore year, and for advanced students who wish a more comprehensive training in the important subject of electro magnetism. Considerable space is devoted to the theory of electrical measurements. The main emphasis, however, has been placed, not on applications of the theory but on instilling correct concepts in the mind of the reader. While the relativity principle—so intimately connected with electromagnetism—is not mentioned *per se*, the point of view of that theory is maintained throughout.

The authors are to be commended for their adoption of the electron theory of matter from the beginning. It is high time that text books discard the antiquated methods of presenting electrical theory used 20 and 30 years ago and adopt the methods that are consistent with modern experimental evidence. The electron theory of matter is entirely adequate to account for all of the laws of electrical engineering.

More space than usual has been devoted to the phenomena of high frequency circuits and electromagnetic waves, matters of great interest to everybody in an age of electrical communication. Throughout the entire book, every effort has been made to develop the subject in a logical manner and not to slight important deductions in order to minimize analysis. Carefully selected problems have been appended to most of the articles.

STEAM TURBINES; publications 45 and 46 of the International Electrotechnical Commission, United States National Committee, Room 1018, 33 W. Thirty-Ninth St., New York, N. Y.; paper, 8 by 11 in., Part I, specifications, 15 pages; price, $0.50. Part II, rules for acceptance tests, 49 pages; price, $1.00.,

These publications, approved by 28 commercial sections, give a set of rules and regulations for use in international commerce. Both parts are published with French and English in parallel columns.

Part I gives: general specifications; information to be supplied with inquiry or order; standard ratings; standard pressures and suggested symbols for use in diagrammatic drawings such as flow diagrams and heat balances.

Part II, which is divided into six sections dealing with rules of acceptance tests, defines some 42 terms and suggests symbols for thermodynamic quantities. Other sections deal with instruments and methods of measurement, methods of calculation and a suggested data sheet for report purposes.

THE AUTOBIOGRAPHY OF AN ENGINEER. By William Le Roy Emmet; cloth, 213 pages, illustrated, size 5½ by 8½ in. The Fort Orange Press, Albany, N. Y., 1931; price, $2.00.

William Le Roy Emmet has long been prominent in engineering circles and though his name was linked for many years with the development of electric ship propulsion, he is best known perhaps for his work in the development of the Mercury Vapor Turbine. This book contains first hand information on many of Mr. Emmet's activities and is enlivened with interesting and intimate glimpses of many of the personalities who were responsible for progress in the power field.

ELECTRICAL EQUIPMENT. By T. C. Lloyd; cloth, 288 pages, illustrated; size, 6 by 9 in. John Wiley & Sons, Inc., New York, 1930; price, $3.50.

This book was written with the idea of presenting material for use by those who have knowledge of the fundamentals of lectrical engineering. The usual course offered to those engineering students who are not specializing in electrical engineering comprises the fundamental principles of direct and alternating currents as applied to circuits. Such courses concentrate on the fundamentals. Beyond a theoretical consideration of the motor, generator and the transformer the student usually learns nothing of the whole field of electrical equipment.

It is for those having had such a course that this book has been written. It presumes a knowledge of the fundamentals but presents to the non-electrical engineering student a brief discussion of the theory of a wider variety of electrical equipment. A few of the chapter headings will serve to give an idea as to the nature of the contents. These are as follows: Types of Electrical Systems, Meters and Measurements, Direct and Alternating Current Generators, Direct and Alternating Current Motors, The Transformer, Storage Batteries, Illumination, Electric Heating, Direct and Alternating Current Transmission, Rectification of Alternating Current, Protection of Electric Circuits, Power Factor Correction, Electric Power Bills, Engineering Economics.

SOVIET FOREIGN TRADE, Menace or Promise. By J. M. Burdick and Samuel S. Shipman; cloth, 276 pages, size, 5 by 7¼ in. Horace Liveright, Inc., New York, 1931; price, $2.50.

During the past year, economic developments in the Soviet Union and more particularly its foreign trade, have been in the forefront of public attention. Now that the results of the first two years of the operation of the Soviet Five Year Plan have made it apparent that the plan is being carried out, misgivings have been expressed in certain quarters as to the possible effect of the development of Soviet economy on world foreign trade, especially that of the United States.

How much truth is there in the allegations regarding Soviet "dumping" or the employment of forced and convict labor? What is the actual status of workers in the Soviet Union? Does Soviet foreign trade constitute a menace or a promise?

These are some of the questions taken up by the authors in this study of Soviet foreign trade, sponsored by the Economic Division of the Amtorg Trading Corporation, which represents the leading Soviet trading and industrial organizations in this country.

The volume includes, besides, a detailed analysis of the character and trend of Soviet foreign trade and of the part which it plays in the national economy of the country as a whole; and an exhaustive analysis of the principal commodities imported by the United States from the Soviet Union—manganese, lumber and pulpwood, safety matches, anthracite coal, etc.—around which so much agitation has centered. It is pointed out that the development of Soviet industry, agriculture and the transportation system promise to make the Soviet Union one of the world's greatest purchasers of the industrial products, particularly machinery and equipment, of which this country is the leading producer.

PRACTICAL ICE MAKING, by A. J. Authenrieth and E. A. Brandt; published by Nickerson & Collins Co., 435 N. Waller Ave., Chicago, Ill.; 6 by 9 in., 179 pages; price, cloth, $3.50; morocco, $4.50.

Compiled from a knowledge gained from actual operating experience with different types of ice plants in practically all sections of the country, this is a practical book for the operating engineer arranged so as to be of service to him in maintaining and improving plant efficiency.

Following a brief presentation of the principles of refrigeration are two exceptionally well arranged chapters on water treatment illustrated by color charts. Chapters on air agitation mechanical equipment, operating efficiency insulation, and freezing systems make the book of unusual value to the up-to-date operating engineer. The book is well illustrated with drawings and photographs and has 18 pages of miscellaneous tables at the back.

ELLIOTT CO., Pittsburgh, Pa., has issued a new Bulletin C-7 on Surface Condensers. A 24-page book, it contains information on the economics of surface condensers information on heat transfer, tube layout and design and gives basic condenser formulas and useful charts. It is well illustrated with condensers of various shapes and sizes and representative installation views.

HEAT TRANSFER in a Commercial Heat Exchanger was made the subject of an extended research by B. E. Short and M. M. Heller at the University of Texas. Results are given in Bulletin No. 29, issued by the University, discussing the effect of velocity, pressure drop, viscosity, relation of length to diameter of cooling tubes and of single versus double pass on the coefficient of heat transfer.

THE IDEAL ELECTRIC & MFG. CO. of Mansfield, Ohio, in its new 16-page Bulletin No. 520 gives descriptive matter, application data, and dimension charts covering the Ideal Flywheel Type Synchronous Motor and six other standard types of synchronous motors, with illustrations of installations.

Two dimension tables are given for each type of machine. The first gives frame sizes and dimension key according to power and speed rating. The second table gives the dimensions corresponding to the frame size and dimension key just determined, so that the reader can obtain approximate dimensions of any of the various types of motors for any horsepower and speed rating.

HAHN STEAM JET CONVEYORS for ash, soot, slag, coke and other abrasive materials are described in bulletin No. 11 just issued by the Hahn Engineering Co., 30 Church St., New York.

AN ALMANAC of thought-provoking suggestions for modernizing industrial plants is being distributed by General Electric Co., Schenectady, N. Y.

ASKANIA STEAM METERS are described in pamphlet 135E, issued by the American Askania Corp., 1603 So. Michigan Ave., Chicago, Ill. In these, a small part of the steam flow, proportioned to the main flow is diverted, condensed and weighed, thus taking care of variations in pressure and temperature.

SHALLOW TYPE Safety Panelboard is described by the Switch & Panel Division, Square D Co., 6060 Rivard St., Detroit, Mich., in a new bulletin containing a description and reproductions of the new panelboards, which are mounted in cabinets 6 in. deep.

The balance of the pages are devoted to price lists. The form number of the new bulletin is CA505A, a supplement of Bulletin CA505, which describes the Square D Standard Safety Panel.

THEORY of flow measurements and the operation, design and construction of the instruments used to measure liquid flow are clearly described in the latest publication, No. 173 entitled Liquid Flow Meters, just published by The Foxboro Co., Foxboro, Mass. It contains 40 pages of engineering information designed to prove useful and interesting to the men responsible for the metering of liquids of all kinds.

TUBULAR AIR HEATERS are described in bulletin G-7, recently issued by the Babcock & Wilcox Co., 85 Liberty St., New York City. A cross section of the heater shows the details of construction, the arrangement of tubes, baffles, casings and detailed discussion is given of these features, as well as of the method of cleaning. Typical boiler cross sections for various methods of firing show how the air preheaters are used under various conditions.

GOETZE IMPROVED VALVE DISC for perfection of valve performance is described in detail and illustrated in an attractive bulletin just published by Goetze Gasket & Packing Co., Inc., 500 Allen Ave., New Brunswick, N. J.

HYDRO-SEAL, a waterproof sealing compound for thread, flange and gasket joints in water, gas and air lines, is described in detail in a recent 8-page bulletin by Quigley Co., Inc., 56 West 45th St., New York City.

LAMOTTE OUTFIT for chemical control of boiler feedwater, a specially designed and improved unit for the power house engineer, containing complete facilities for the accurate, rapid and convenient testing of raw and treated boiler waters for dissolved oxygen, total alkalinity, hardness, pH value, sulfates, chlorides and phosphates, is described and illustrated in detail in a recent bulletin published by The LaMotte Chemical Products Co., McCormick Bldg., Baltimore, Md.

CATALOG H, recently published by Victor Mfg. & Gasket Co., 5750 Roosevelt Road, Chicago, Ill., comprises a handy reference manual containing nearly 100 pages of data concerning gaskets, gasket materials, and packings for industrial and commercial uses. Featured are listings, illustrations and recommended constructions of metal-asbestos gaskets such as ring, closed, French and flange types. Included also are a number of special gasket groups such as locomotive, oil refinery, marine, refrigerator, drum plug, flange union, valve disc and others. In addition are descriptions of folded-asbestos handhole and manhole gaskets, non-metallic gasket materials and sheet packings such as compressed asbestos, fibrous, cork and rubber. A section is devoted to various types of rod packings such as high-and-low pressure, braided and twisted asbestos, flax, wick and rope packings supplemented with tables of engineering data.

BULLETIN No. 160 of the Centrifix Corp., 3029 Prospect Ave., Cleveland, Ohio, shows the operation of steam, gas and air purifiers for use inside boiler drums and in pipe lines, to remove moisture, oil and dust. Copies will be sent on request.

COMPLETE CATALOG on standard and special elevating and conveying machinery has recently been published by The Fairfield Engineering Co., Marion, Ohio. Throughout its hundred pages, it contains information needed by buyers of elevating and conveying machinery to aid them in suitable selection for their particular needs. Subjects covered extensively are: The Selection of a Belt Conveyor; Storage Silo Systems; Power Plant Equipment; The Installation of Bucket Elevators; V Bucket Conveyors; Flight Conveyors; Apron Conveyors; Package Conveyors; Spiral Conveyors; Skip Hoist Installation; Railroad Equipment; the use of Coal Handling Equipment and many others. Many blueprint installation diagrams and views of actual installations are included.

DETAILED DATA regarding the improvements and advantages of the new Super-Johnson clutch are given in a new letter-size 32-page illustrated bulletin published by the Carlyle Johnson Machine Co., Manchester, Conn. In this new type of clutch the expanding friction ring is faced on its outside diameter with a special heat resisting material.

T-TRI-LOK BRIDGE FLOOR CONSTRUCTION, materials used, methods of erecting and test data are described in an illustrated 24-page bulletin just issued by Carnegie Steel Co., Pittsburgh, Pa.

FROG LEG ARMATURE WINDINGS for multi-polar direct current generators and motors, to insure successful commutation, are described in detail in a new publication No. 2135 issued by Allis-Chalmers Mfg. Co., Milwaukee, Wis.

NEW DOUBLE REDUCTION Herringbone-Maag Speed Reducers for small motor drives are described in Bulletin 53, just issued by W. A. Jones Foundry and Machine Co., 4401 West Roosevelt Rd., Chicago, Ill. In design, construction and manufacture, these small machines are the same as the heavy duty reducers. Double helical gears, accurately generated right and left hand, in effect a herringbone gear with a wide gap, are used for the initial, or high speed, reduction. The low speed reduction consists of an accurately generated Maag pinion and gear. Timken bearings are used throughout.

IN THE MAGAZINE ARTICLE, a recent book by Robert P. Crawford, (Mc-Graw-Hill Book Co., N. Y.) the value of original ideas and initiative as compared to mere good memory is emphasized. Men with new ideas are always welcomed as contributors to magazines and are likely to achieve success.

GAS ENGINE EFFICIENCY Insured With the Maihak Indicator is the title of Bulletin 3265 just issued by Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa. This describes the indicator and discusses its use in gas engine operation.

REPORT OF TESTS of the Whiting stoker with Indiana coal for the Joseph Harrington Co., subsidiary of the Whiting Corp., Harvey, Ill., made at the mechanical engineering laboratory, Purdue University, LaFayette, Ind., are given in a recent bulletin issued by the Joseph Harrington Co. The bulletin describes the equipment used, the conduct of the tests and gives tabulated and graphical results for the different coals burned.

THE HOUGHTON LINE, which was discontinued in 1929 is to be riveted, with Louis E. Murphy, president of E. F. Houghton and Co., Philadelphia, as directing editor. It will be used as a medium of free discussion, one of the leading articles in the September issue being on The Effects of Feminine Whims on Policies of the U. S. Government.

WORM GEAR SPEED REDUCERS are described in Catalog No. 50, a 64-page illustrated bulletin of letter size just issued by W. A. Jones Foundry and Machine Co., 4401 Roosevelt Rd., Chicago, Ill. This bulletin gives general description of types HR, OH and HS reducers, details of design and construction, horsepower ratings, dimensions and weights, horsepower and other related engineering data.

COMPLETE INFORMATION on Morse Stock drives including list prices of all drives up to 50 hp. is given in bulletin 44 just published by Morse Chain Co., Ithaca, N. Y. In this 56-page, letter-size, illustrated bulletin, all types of these drives are described in detail and their applications illustrated, with tables of sizes and capacities and data on chain cases, sprockets, hunting links, installation and lubrication.

HELPFUL IDEAS for Engineers from the Smooth-On handbook are given in a new 32-page illustrated bulletin just published by Smooth-On Mfg. Co., 568 Communipaw Ave., Jersey City, N. J. The booklet shows various uses for Smooth-On in preventing leaks, making repairs of various kinds on piping, fitting, steam and water jackets and many other types of engineering equipment and giving details of the methods employed. This booklet will be sent free on anyone on request to the above address.

SUPPLEMENTARY SECTION to Bulletin CA-505, which describes its standard convertible safety panelboard and supplementary section, Bulletin CA-505-A, which describes the new shallow type convertible safety panelboard with capacities up to and including 100 amp., 250 v., have just been issued by Square D. Co., Detroit, Mich.

CIRCULAR 1921 covering types GO, GO-1, and GO-2 oil circuit breakers, a line of low-capacity outdoor breakers for use in distribution or low-voltage transmission systems has just been issued by The Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa. Construction and operation details, style numbers and a number of illustrations are included.

THE FULLER LEHIGH Co., 85 Liberty St., New York City, has just issued Bulletin No. 906, describing and illustrating the company's new Type C pulverizer. This pulverizer is an efficient means of pulverizing coal for small and medium sized, direct fired boilers. It is especially adaptable to firing melting furnaces, core ovens, heating furnaces and similar applications. Information is given on the construction, application and operation of the equipment. In addition, there is a large cross sectional illustration of the pulverizer and an arrangement drawing which shows a unified design of a modern steam generating unit for industrial application.

IN AN ATTRACTIVELY-BOUND 32-PAGE bulletin, No. 174, a complete line of controlling, recording, indicating instruments for temperature, pressure, humidity and flow is described by the Foxboro Co., Foxboro, Mass. Details of the instruments are given, with description of their construction and operation and many interesting photographs of their application to all types of power plant and industrial service.

Power Plant Construction News

Calif., Long Beach—The Long Beach Market Co., Broadway and Atlantic Avenue, plans installation of power equipment and electric-operated refrigerating machinery in new shop and market building on Broadway, near Lime Street, entire project estimated to cost about $400,000.

Ga., Augusta—The Augusta Canal Co., Augusta, is said to have plans nearing completion for a proposed new electric generating plant to cost close to $1,000,000, with machinery. The Burns & McDonnell Engineering Co., Interstate Building, Kansas City, Mo., is engineer.

Ky., Bowling Green—The Bowling Green Refining Co. has approved plans for a local oil refining plant to cost about $85,000, and will install bubble tower, stills, pumping machinery and auxiliary equipment.

Ky., Ludlow—The City Council plans installation of pumping machinery, water softening equipment and other mechanical apparatus, in connection with extensions and improvements in municipal waterworks. Entire project is reported to cost about $120,000. Glazier & Morlidge, 305 Walnut Street, Cincinnati, Ohio, are engineers.

Ky., Mount Sterling—The Board of City Commissioners, Mount Sterling, has secured a report from the Burns & McDonnell Engineering Co., Interstate Building, Kansas City, Mo., regarding construction of a proposed municipal electric light and power plant, and is expected to authorize the project at an early date. Estimated cost has not been announced.

Mass., Boston—The City Ice & Fuel Co., 6611 Euclid Avenue, Cleveland, Ohio, and 68 Lowell Street, Boston, Mass., has filed plans for a new one-story ice-manufacturing and refrigerating plant, 100 x 250 ft., reported to cost about $75,000, with equipment.

Mich., Marquette—The Michigan Gas & Electric Co., Marquette, has approved plans, extensions and improvements in local artificial gas plant, including installation of additional equipment.

Mich., Wyandotte—The Department of Municipal Service, Wyandotte, has plans nearing completion for extensions and improvements in municipal electric light and power plant, including installation of additional equipment, estimated to cost about $300,000. The Froehlich & Emery Engineering Co., Second National Bank Building, Toledo, Ohio, is consulting engineer.

Mo., Callao—The Missouri Power & Light Co., Kansas City, Mo., has negotiations under way for the purchase of the municipal electric light and power plant at Callao, and proposes to carry out an expansion and improvement program in that district, including transmission line construction.

N. Y., New York—The Board of Education, Park Avenue and Fifty-ninth Street, plans installation of electric motors, controls and other power equipment in connection with establishment of vocational shops in a group of about 25 existing junior high schools, entire project reported to cost over $350,000. W. C. Martin, Flatbush Avenue Extension and Concord Street, Brooklyn, N. Y., is architect.

N. Y., Randolph—The Central Rural High School District, Randolph, A. W. Harkness, district superintendent, plans installation of electric motors and other power equipment in vocational training shops to be installed in proposed new local senior and junior high school. Project will also include a boiler plant. A bond issue of $290,000, has been approved for the unit.

N. Y., Wallkill—The Department of Correction, Albany, N. Y., plans construction of a power plant, in connection with new state prison at Wallkill, entire project to cost $1,450,000. Work will also include a mechanical laundry and industrial shops.

Ohio, Cincinnati—The Queen City Bread Co., Cincinnati, plans installation of boiler equipment, ovens, conveyors, and other mechanical power equipment in proposed new baking plant on Herald Avenue, entire project reported to cost $250,000. Hillsmith & Co., Winters Bank Building, Dayton, Ohio, are engineers and will be in charge of erection.

Ohio, Cleveland—The Hughes Provision Co., 3199 West Sixty-fifth Street, will soon begin construction of a one-story power house at its factory, estimated to cost about $50,000, with equipment.

Ohio, Eaton—The City Council is considering extensions and improvements in municipal electric light, power and water plant, including installation of two new generators, 200 kw. and 500 kw. capacity, respectively, boilers, condensers and accessory equipment. A bond issue is being arranged for the program. A. L. Reed is engineer in charge.

Ohio, Norwalk—The City Council plans installation of pumping machinery and other power equipment in connection with a proposed sewage treatment plant to cost about $350,000. It is expected to ask bids in October. The H. P. Jones Co., Second National Bank Building, Cleveland, Ohio, is engineer. G. E. Scott is city engineer.

Ohio, Piqua—The Board of City Commissioners plans to call a special election in November to approve a bond issue of $810,000, for construction of a municipal electric light and power plant. The Burns & McDonnell Engineering Co., Interstate Building, Kansas City, Mo., is engineer.

Ohio, Wellsville—The City Council plans installation of filtration equipment, pumps and auxiliary machinery, in connection with extensions and improvements in municipal waterworks. New water meters will also be installed. A bond issue is being arranged.

Okla., Erick—The Common Council has been authorized by a vote of citizens to arrange for a bond issue of $25,000, proceeds to be used for the installation of a municipal gas plant.

Okla., Hominy—The Common Council has arranged for a bond issue of $150,000, the fund to be used for a municipal electric light and power plant, for which plans are being completed by V. V. Long & Co., Colcord Building, Oklahoma City, Okla., consulting engineers.

Pa., Ford City—The Board of City Commissioners has plans under way for extensions and improvements in municipal electric light and power plant, including installation of a 500-kw. Diesel engine unit and auxiliary equipment. The Burns & McDonnell Engineering Co., Interstate Building, Kansas City, Mo., is engineer.

Pa., Norristown—The Penn Tack Co., Norristown, plans installation of electric power equipment in connection with rebuilding of portion of plant recently destroyed by fire with loss of about $100,000.

S. C., Aiken—The Commissioner of Public Works, Aiken, is considering the installation of a pumping engine for waterworks service, with capacity of about 800-gal. per min., including accessory equipment. Harry Sudlow is superintendent.

Texas, Houston—The Texas Bag & Burlap Co., 3203 Polk Avenue, is said to be planning installation of electric motors and other power equipment in connection with proposed rebuilding of portion of plant recently destroyed by fire with loss of about $40,000.

Texas, Houston—The Texas-Empire Pipe Line Co., Houston, an interest of the Texas Co., Texas Building, Houston, plans the installation of a group of five pumping plants in connection with a new pipe line from the East Texas oil fields to Port Arthur, about 205 miles, entire project to cost close to $3,000,000. Pumping stations will be electrically-operated and will cost about $500,000, with machinery.

Va., Lynchburg—The Lynchburg Gas Co., Lynchburg, plans installation of additional equipment at its local artificial gas plant, including steam turbine unit, feed-water heater, feed-water pumps and auxiliary apparatus.

Wash., Everett—The Puget Sound Power & Light Co., Seattle, is planning extensions and improvements in power substation at Everett, including installation of transformers and other equipment, estimated to cost close to $150,000. Company engineering department is in charge.

Wash., Tacoma—The Metropolitan Water District, Tacoma, in co-operation with the Tacoma Smelting Co., plans installation of a water supply system in the Point Defiance Park district, including installation of a 100,000-gal. steel tank, pumping machinery and auxiliary equipment, entire project reported to cost close to $25,000.